HISTORY

OF THE

BERWICKSHIRE

NATURALISTS' CLUB

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"MARE ET TELLUS, ET, QUOD TEGIT OMNIA, CŒLUM"

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CLUB NOTES

The greater prominence given to the *Field Secretaries' Report* in the last Part, as an individual heading, is continued in the present one; the Report provides a valuable record of the excursions of the *Club*. The *Advice to Contributors*, printed on the inside of the back cover of the last Part, attracted favourable comment and has been slightly expanded. With the agreement of the *Club* Council, the system of numbering the volumes of the *History* has been changed from Roman to Arabic, for quicker reference.

Two natural history contributions, respectively on wild plants and on beetles, have pointed up the importance of relating records to the Watsonian Vice-counties of the British Isles (p. 106). The description of the country-wide system for recording bird observations, kindly provided by Mr. R. D. Murray, for *Field Notes and Records*, will, it is hoped, encourage their being noted.

A more extended description of the scope and function of the *Club* Library, and of access to it, is included this year in the *Librarian's Report*, to facilitate Members' use.

Can anyone identify the sketch (p. 112) of a gateway arch?

PROCEEDINGS

OF THE

BERWICKSHIRE
NATURALISTS' CLUB

A SHORT HISTORY OF AGRICULTURE AND RURAL LIFE IN THE BORDERS

being the Anniversary Address delivered by Lt. Col. Sir William Swan K.C.V.O., C.B.E., President of the Club, on 20th October, 1988.

I have chosen this subject for my Anniversary address to the Berwickshire Naturalists' Club because I feel that for many years the story of agriculture and rural life in general has been so much the history of Scotland as a whole and, in particular, of Berwickshire and the Borders.

The area of farming and forestry in the Borders today is just over one million acres and Berwickshire comprises something less than one fifth of the total.

The earliest settlements in the Borders, of which traces still remain, were the hill forts erected by Celtic tribes from about 1000 BC until after the Roman occupation. The land adjacent to the forts was cultivated in a series of terraces. The largest hill fort appears to have been situated on the summit of the Eildons at Melrose and is said to have been utilised by the Romans for a period, as a signal station.

In those far off days the bulk of the lower ground was covered by trees and scrub. Man was as dweller in forests. The forest was his nursery, his shelter from the weather, his hunting ground, the inspiration of his culture, the centres of tribal and religious assembly, in short the cradle of early civilisation.

The state of agriculture in mediaeval times, following the departure of the Romans, was primitive and poverty-stricken. However, the establishment of the monastic settlements and

the building of the abbeys in the 11th century brought some improvement.

The monks and their lay brethren were enterprising and benevolent agriculturalists. In particular, they introduced sheep in large numbers in the areas they controlled. For example, about the year 1250, Melrose Abbey had over 12,000 breeding sheep and Kelso Abbey upwards of 2,000.

Sadly, the destruction of the Abbeys by the English in the 14th and 15th centuries resulted in a serious decline in agriculture, generally, in the Borders; and indeed even by the start of the 18th century the industry was still very much in the doldrums.

At the start of the 18th century Scotland as a whole was in a sorry state. At that time the population of the country was just over one million, compared with five and a half million today. It has been estimated that one in five of the people lived on the verge of utter destitution. Frequent epidemic diseases took a heavy toll among a people, whose habits provided a ready breeding ground for such scourges and whose ill nourished bodies were capable of little resistance.

Roads in the country were virtually non-existent and housing conditions quite deplorable. Edinburgh with its congested tenements and narrow streets, which served as open sewers at nightfall, must have been quite nauseating; and the villages were even worse. The houses consisted of untidy huts made of rough stones and mud with no windows or chimneys and turf roofs.

One traveller from England on a visit to Eyemouth wrote, "Plenty of claret and very cheap, but the food was so repulsive, the town so stinking, the houses and inhabitants so miserable that it was with sorrow I beheld them." A sad commentary!

The diet of the ordinary people in the country was monotonous in the extreme, inadequate in quality and quantity. The staple diet was mostly oatmeal, taken in the form of porridge, or brose when mixed with pease meal, insipid in taste because of lack of salt due to the salt tax. The normal method of eating was for members of a household, each armed with a horn spoon, to gather round a simple wooden dish and help themselves collectively – like our farm animals of today feeding out of a central trough!

I have dwelt at some length on the period of the late 17th and early 18th centuries, because, from research into mate-

rial that several kind people have let me have, it seems that this period was the turning point in the history of agriculture in Scotland, locally and nationally. From a dreadful abyss of poverty and misery living conditions gradually began to improve.

For one thing, the beneficial effects of the Union with England in 1707 after a little time began to make themselves felt. A sum of £400,000 was paid over by England to Scotland under the terms of the treaty. This sum amounted to nearly two-thirds of the currency in circulation in the country at the time and gave a massive boost to the Scottish economy and to early industrial developments.

When more peaceful relations were established after the Union, intercourse with England became more common. English visitors found much to criticise in the Scottish farming field, but Scottish visitors to England discovered much to admire and learn from in an agriculture years ahead of theirs.

Many of those who learned from English practices became pioneers of new methods in Scotland and came to be known as the improvers. Berwickshire men, like Lord Kames and Dr James Hutton of Slighhouses Farm, were among the leading improvers. In 1763 James Small of Blackadder Mount invented a two horse swing plough, which was to transform, ploughing techniques in the years ahead.

The normal practice at this time was for each farm to be run by several tenants, cultivating the land on a strip or runrig system. The runrigs were usually about an acre in size, i.e., 200 x 24 yd., and the land was ploughed round and round, so that the middle was higher than the outside area and the water drained to the low ground at the edges. Runrigs were transferred among the tenants annually, so that each got a turn of the better strips. The plough used was the old Scots plough, an unwieldy, heavy implement, which required 8 oxen to pull it; each tenant supplied one or more oxen to the team.

As a result of lessons learned from England, many lairds realised that the runrig system was cumbersome and wasteful and took steps to bring in better methods. These consisted of draining and enclosing the land, using dykes, hedges and ditches as divisions, planting trees, laying roads and erecting buildings. For instance, I learned from Mrs May Dunlop at Mayfield, one of the kind people who helped me with my researches for this address, that the present farm house and

cottages at Mayfield were built by John Dunlop in the 1830's. I expect the steading was built and field enclosures introduced about the same time. Incidentally, Mrs Dunlop has in her possession a fine drawing of Mayfield farmhouse, done by Mrs Catherine Dunlop, John's wife, who was a sister of Dr Johnston, who founded the Berwickshire Naturalists' Club in 1831.

By the end of the 18th century the process of modernisation of Berwickshire and Border farms was well-nigh complete; the actual layouts, in many cases, have probably changed little today.

The greatest credit for this remarkable transformation must go to the landed proprietors, who displayed admirable foresight in the way they laid out their properties. These men of vision were largely responsible for creating the beautifully varied and colourful Border land we know today.

The story of agriculture in the 19th and 20th centuries is very much one of boom and slump. Prosperity during war time when the country needed extra food from home production and depression during peace time when cheap food was often available from abroad and farming at home was neglected. Fortunately, since the 1939-45 war this has not been the case and a system of minimum guaranteed prices has brought greatly increased efficiency and reasonable prosperity to agriculture and the countryside. Currently, with the effects of food surpluses in the E.E.C. hanging menacingly over the industry, the future is less clear.

Up to now I have been tracing the evolvement of our rural life in the Borders, and in the area covered by the Naturalists' Club, in general terms. I would now like to turn from the general to the particular and relate some stories connected with individuals, who played their part in the making of this rural history.

Improvement in the lot of the farm worker did not take place quite as quickly as did the transformation of the industry between 1800 and 1900. However, by the 1920's conditions began to get better, particularly in housing. The Farm Servants Union, formed in 1912 by Joseph Duncan, was by the 1930's in regular consultation with the Scottish National Farmers Union, an agreed wages schedule was introduced, which brought well deserved benefits to the farm worker. These included a minimum wage for each category, an assessment of the monetary value of perquisites, regular

holidays and hours of work. About that time too, the annual Hiring Faires were abolished. Instead of proceeding to Berwick or Duns Hiring Markets once a year to engage employees, farmers had to resort to the press as a means of advertising vacancies and securing workers.

In 1770 one David Ure, who had been in America, introduced tobacco growing near Newstead, Melrose. His first trial grew well; he cured and spun the product and sold it readily. It was then tried with success in neighbouring parishes and soon many hundreds of acres were being grown, often making profits of up to £70 per acre. But for some unexplained reason the practice was stopped by Act of Parliament.

A significant development in the marketing of livestock took place towards the end of the 19th century, a development in which my forebears were involved. In 1875, my grandfather, W. B. Swan, and my great uncle, R. G. Swan, formed R. G. & W. B. Swan Ltd. to market livestock by auction at Duns and Reston, instead of by private treaty at the numerous Livestock Fairs which were held in different locations. I quote from a poem by Mr. A. Balsillie, heralding this development, entitled:–

Duns Show, April 1878.

Yae day as I went into Duns
I in amazement stud
Tae see a thing half round half square
And a' done up in wud.

Tae ask about this curious thing
I stopt a man and cart
Says he I'd thought you'd kent 'bout that
That's Swan's new Auction Mart.

Qou' he this day you'll see a sight
Then to his horse cried 'wo'
You're lucky coming at this time
This is his Annual Show.

Next man I met had gie red face
You'd thought he'd had some grog
He put a paper in my hand
Ca'd it a catalogue.

The actioneers both did their best
Good prices they did bring
But, mind, the beese and sheep looked fine
Inside yon grand new ring.

Willie the cattle sold first class
And spoke out like a man
While a' the rough and clippit sheep
Were sold by Robert Swan.

The stock being sold I took a nip
And started home at once
And said it was the biggest day
I'd ever see in Duns.

Then I quote from John Clay's Memoirs:

"In the 1850's there was a wonderful lot of progressive farmers in the Merse. Among those was one, John Blackadder, a great wit and master of repartee. He farmed at Ninewells Mains, Chirnside, his factor being Thomas Bowhill of Ayton, a very clever country lawyer. The proprietor of Ninewells, having died, was succeeded by a gentleman who belonged to a curious religious sect called the Society of Angels. Shortly after the new owner took over Mr Bowhill met Mr Blackadder and remarked, "Aye, Mr Blackadder You'll be grandly off now having an angel for a laird". "True, true," replied John Blackadder, "but unfortunately I've got a deil for a factor." To let you into a secret, the deil referred to was a distant relative of our worthy secretary! She, of course, is an angel!

And so ends my story. As I studied afresh the days of long ago and considered the many privations our forebears suffered, one inescapable conclusion came to mind. How fortunate we are to be living at this time!

WILLIAM CROW OF NETHERBYRES (c. 1704-1750); A SKETCH OF HIS LIFE AND WORK

Stella Mills
Department of Scottish History, University of Edinburgh

After the Union with England in 1707, and during the first half of the 18th century, Scotland began to move towards being a much more stable state both politically and economically. The Act of Succession, ensuring a Protestant Monarch on the throne of Great Britain, helped to reassure the Presbyterian Kirk that Episcopalianism would not be forced upon an unwilling Church and thus religion and State, after the turmoils of the 17th century, were able to settle down to structuring themselves into stable entities. The Union meant that the finest schools in England were available to those Scots whose parents could afford the fees and so, by the middle of the 18th century, English customs were having a major influence north of the border with Scotland.

Of course, there was an interchange, not only of social customs, but of philosophy, ideas and thoughts in general. Thus, by about 1750, that period of free, radical thought, known as the Enlightenment, had begun both in England and Scotland. But it did not begin in a vacuum. A number of people played a major rôle in the first half of the 18th century by encouraging experimentation in many different disciplines and, in Scotland particularly, these people ranged from academic professors to landed aristocracy who allowed their estates to be used to accommodate practical experiments. This pre-Enlightenment Age saw a close co-operation and pooling both of ideas and resources by all classes of Scottish people.

One such landed gentleman, who played an important part, particularly in the development of mechanical machines and the theory of the motion of fluids, was William Crow of Netherbyres, whose estate of Netherbyres was (and still is) near Eyemouth, in the Parish of Ayton, Berwickshire. Today his name is practically unknown even among academic historians of science but there can be little doubt that he made some important discoveries which should be better known today.

The family of Auchencraw[1], or, as they had become known by the seventeenth century, the family of Craw or Crow, was an old Berwickshire family centred on the village of Auchencraw. Even so, little is known of the ancestors of William Crow except that before 1550, his family had acquired the estates of Netherbyres (near Eyemouth), Gunsgreen and Flemington, adding, in 1612, that of Redhall. In 1648, a George Crow of Netherbyres was a Commissioner of Supply. This George may possibly have been William's father as, on 10th February, 1704, the latter decided to make his Will[2] since: 'those of younger years and More Stren[g]thly are

dropping into Eternity'. From this Will we learn that William was George's only son and heir and was to inherit 'y^e small estate I possess' which was centred around Netherbyres. However, so that his son would 'not undergo y^e tryall of Husbandrie' when his wife had completed her duties as 'his tutor and Governour During his minority', George 'ordained' that the 'Land May be sett The value of y^e Stock and Crop laid out To y^e best advantage...'. Should his mother still be living when William was to come of age, he was to free her of 'all Publick burdens' by paying her 400 merks[3] annually and allowing her to live in the 'Third room of y^e house east end of y^e hall'. George concluded his Will with the precautionary measure that if his wife remarried then William's education and the 'manadgement of his forton' were to be left to friends.

By May, 1706, George Craw (or Crow – during the 18th century either surname was used) had died and William, still a minor, took possession of Netherbyres[4]. Unfortunately, all the Parish Records for Ayton, in which Parish Netherbyres lies, are destroyed for this period so we cannot ascertain whether or not William's mother tutored him or when she died, just as we cannot give an exact date of birth for William.

However, one of the 'friends' mentioned by George Craw in his Will[5] was 'ye heir of Linthill' and, in 1729, a Sasine was drawn in favour of William Crow by William Home of Linthill. Besides some lands, the Sasine mentioned Crow receiving a heritable bond for 3,000 merks. While there is no actual extant evidence, it would seem from this that William's mother either died or remarried before William was of age and his education and welfare was looked after by William Home in accordance with George Craw's Will. We can be fairly certain then, that William was born in 1704. From his tombstone (vide infra) we can deduce that he must have been born in December, 1704. However, there can be no doubt that William's education was not neglected for in 1720 he graduated Master of Arts from the University of Edinburgh. His interest in learning, and particularly in applied mechanics, were to remain with him for the rest of his life and not only did he keep contact with the learned society of Edinburgh but also made full use of his inventive nature.

After graduation, he appears to have returned to his estate at Netherbyres, taking a particular interest in horticulture. In 1729, he purchased three acres of arable land, with parsonage and vicarage tithes and all the salmon fishing-rights in Ayton Parish[7]. But learning and research were often in his mind and in June 1737 he became one of the founder members of the Edinburgh Philosophical Society[8]. The membership of this Society was limited to 42, the majority of whom were University Professors and titled aristocracy. The Society met monthly, September and October excepted, and one of its secretaries was Colin MacLaurin (1689-1746), Professor of Mathematics at the University of Edinburgh[9]. It is from

Crow's correspondence with MacLaurin, together with some manuscripts of MacLaurin, that we can gain a relatively full picture of Crow's activities in 1739 and 1740 and thus make some assessment of the value of Crow's inventive thought.

During the summer of 1739, the Earl of Morton, also a member of the Edinburgh Philosophical Society, planned an exploratory expedition to the Shetland Islands. MacLaurin was disappointed that his commitments in Edinburgh prevented his accompanying the voyage but he took 'leave to offer some hints'[10] as to some experiments the expedition members could try. He suggested 'a Journal should be kept of their voyage from their first setting out till their return' and this should record 'every occurrence of the least note'. In particular,

> 'The shining of the sea or not if it be dark enough to make it sensible, or an experiment of it in a glass in a dark room when struck as M^r^ Craw has often tryed'.

Whether or not Lord Morton's party tried Crow's experiment is not known but this comment by MacLaurin does serve to illustrate what was a major interest of Crow – the motion of water.

On 26th February, 1739, Crow wrote a long letter[11] to MacLaurin from Netherbyres wanting to know how to determine the velocity of running water, knowing only the depth of water and its angle of inclination. He told MacLaurin that he needed more information because he wanted to try out accurately a method he had showed him the 'last time I had the pleasure of seeing you in town'. In essence, Crow wanted to know the correct relationship between the velocity of a river and its depth so that he could construct properly his 'Artificial foord' and hence 'save the expence of bridges' by crossing small rivers by means of a ford.

His letter indicated that Crow was well read in all the then current literature on fluid mechanics. Mariotte[12] and 's Gravesande[13], he felt, did not really consider the problem of fords but he took issue with 's Gravesande's suggestion 'that different heights of water in the channel, make no alteration of the Velocity'[14]. This, he was sure, would be found incorrect, 'both to reason and experience'.

Then, while he 'was casting about for more information on this Subject' he found, 'bound up with Gallileo's works, in an unportable foilio', a work dated earlier than those of Mariotte or 's Gravesande, about the motion of water, by Benedetto Castelli[15]. This work, in two parts, was originally written in Italian, the first part being published in 1628 and the second in 1641. But from Crow's description it is obvious that he used the English translation of both parts given in a collection of essays by Thomas Salusbury, and published in 1661.[16] Crow thought Castelli gave 'many usefull propositions' but took issue with Theorem 2, Book 2[17]:

> 'If a River increase in quick height, the quantitie of Water which the River dischargeth after the increase, hath the Proportion compounded

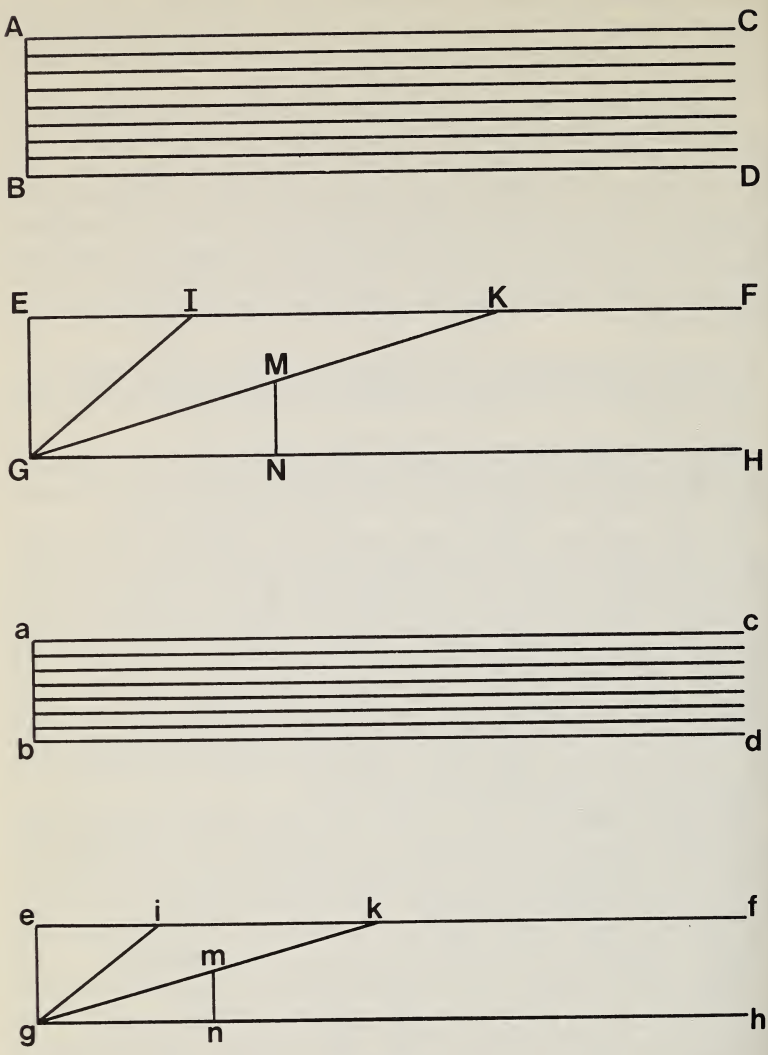

Diagram 1.

of the Proportions of the Quick height to the Quick Height, and of the velocity to the velocity'.

Thus, by this theorem, Crow pointed out[18], if 'the river be swell'd to double the former depth, the velocity shall likewise be doubled' – a thought which prompted from him (quite correctly): 'that tho' Castelli was Mathematician to the Pope, he might not be Infallible'.

Crow then described the experiment Castelli had used to arrive at a table which illustrated an important Corollary[19] of Castelli:

> '... that the quantity of the Water that runneth, whilst the River is high, to that which runneth, whilst it is low, hath duplicate proportion of the height to the height, that is, the proportion that the squares of the heights have'.

In modern terminology, Castelli has here asserted that the discharge, Q, varies as the square of the depth of the water, which is incorrect.

Crow promised MacLaurin he would try Castelli's experiment when the weather was warmer and went on to relate his own experiment which he made before consulting any of the literature he had mentioned.

For simplicity Crow considered a horizontal canal full of water, ACDB (Diagram 1).[20] EFGH represents a 'profile lengthways of the canal', where EF is the surface of the water and GH the canal bottom. Now let acdb be another canal 'in all respects equall to the former, except the depth' with efhg the profile diagram corresponding to that of EFHG.

Because of the equality of the motion of falling bodies with that of the velocity of the water in the cross-section EG, Crow asserted that the velocities of:

every particle of water in the section EG, or (eg)' will be as $\frac{\sqrt{EG}}{2}$: $\frac{\sqrt{eg}}{2}$ or '(because halfs are as their wholes) As $\sqrt{EG} : \sqrt{eg}$'.

If, as Crow seemed to imply, the canals are kept full, this is correct for, in modern theory we have for each canal: $v^2 = 2gh$ where v is the velocity, g the acceleration due to gravity and h the depth of the water in the canal. Thus, letting v_1 and h_1 be the velocity and depth of the water in the canal ACBD and v_2 and h_2 the corresponding velocity and depth in the canal acdb, we have

$$\frac{v_1}{v_2} = \frac{\sqrt{2gh_1}}{\sqrt{2gh_2}} \text{ or } \frac{v_1}{v_2} = \frac{\sqrt{h_1}}{\sqrt{h_2}}.$$

It is doubtful, however, whether at this stage in his knowledge, Crow was completely confident of the theory behind his own results which he obtained by detailed and careful experiments.

Crow next pointed out[21] to MacLaurin that when the water is allowed to flow:

> 'The surface of y^e water in the two canals, will immediately form themselves into similar inclin'd planes, as GI & (gi), GK and (gk), in which the velocity of the water is gradually retarded...'.

Although Crow seemed to be sometimes confused as to whether he measured the depth of water from the surface of the water or the bottom of the canal, since he asserted that the water on the surface is at rest, which is incorrect, he seemed here to have recognised that

the velocity contour in a river is not linear. In today's terminology, assuming the river to be in laminar flow, the velocity contour is approximately parabolic; that is, in viscous laminar flow the velocity distribution is as in Diagram 2.

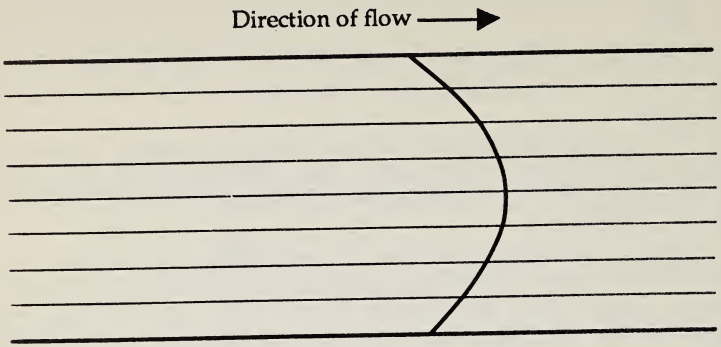

Diagram 2.

Reasoning as before, Crow correctly asserted that the velocity of the section MN to that of the section mn (Diagram 1) is $\sqrt{MN}$ to $\sqrt{mn}$.

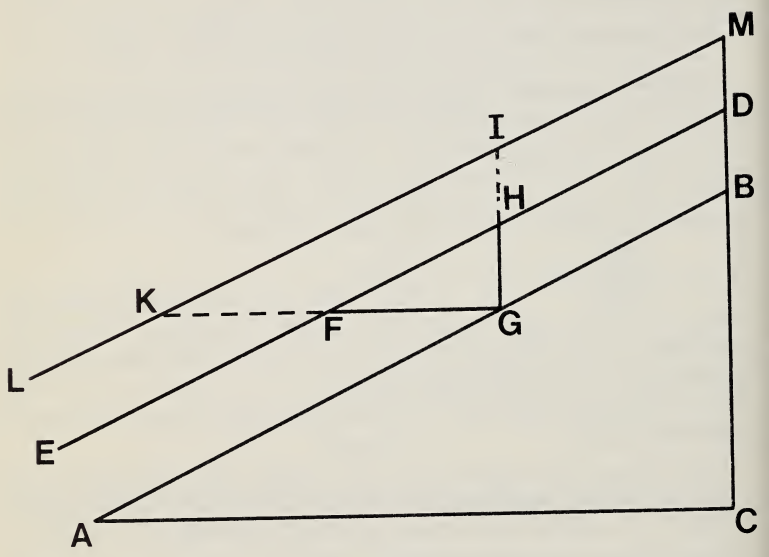

Diagram 3.

He next applied this to 'rivers of considerable declivity' (Diagram 3), where AB is the river bottom inclined at an angle BAC. The

surface of the water in ordinary state is represented by DE while that in flood is shown as ML. By considering the velocity distribution along FG and KG to be constant in each case, Crow correctly reasoned that the velocity along GK to that along GF is as $\sqrt{IG}$ to $\sqrt{HG}$. If we now assume the velocity gained by means of the inclined plane to be invariable and equal to b, then

> '... the velocity of the river in its natural state, will be to that of the flood water, As $b + GH^{\frac{1}{2}} : b + IG^{\frac{1}{2}}$.'

Thus in any river whose bottom is regular 'and either horizontal, or very moderately inclin'd, (so that b = O) the ratio of the two velocities is 'in the sub duplicate ratio [i.e. the ratio of the square-roots] of the depths'.

Crow then proposed the problem which had originally prompted all this research:

> 'The profile or cross Section of a river given, whose banks are paralel, and bottom is nearly horizontal, to determine how high the water will rise upon an artificial ford, whose breadth is also given'.

Using Crow's notation, we call the breadth b and depth d of the river in normal (laminar) flow and the breadth of the ford c and the required depth x. Working in modern terminology and theory, which here coincides with Crow's working, we can assume that the actual flow-rate and discharge Q are constant and so obtain Q = cross-sectional area x velocity = $bd\sqrt{d}$ for the river in normal flow and $Q = cxx^{\frac{1}{2}}$ for the river at the ford. As Q is constant, we have $bdd^{\frac{1}{2}} = cxx^{\frac{1}{2}}$ which yields $x^3 = \frac{b^2d^3}{c^2}$. Crow pointed out that by Castelli's theory the solution would be $\frac{bd^2}{c} = x^2$ while 's Gravesande's theory would give $\frac{bd}{c} = x$.

After remarking on the relative folly of being able to 'take the dimensions of Saturn's ring, while we are uncertain ...' about the motion of rivers, Crow respectfully asked MacLaurin 'to set your fluxions to work on this subject'[22] and give him the correct answer. A postscript to this long letter indicated that Crow used 's Gravesande's 'quadrant method' for measuring the velocity of the water. This was a relatively complicated piece of apparatus (Diagram 4) but a very adequate description was given in Desaguliers' translation of 's Gravesande's *Physices Elementa Mathematica* ...[23], published in 1721, and it is, no doubt, from this translation that Crow took the details and was able to make his own version of the 'machine'. It is ironical that Crow using another man's invention was able to arrive at the correct result that for laminar flow the velocity of the water is proportional to the square-root of the depth while 's Gravesande himself could only give a theory too simplified to be correct.

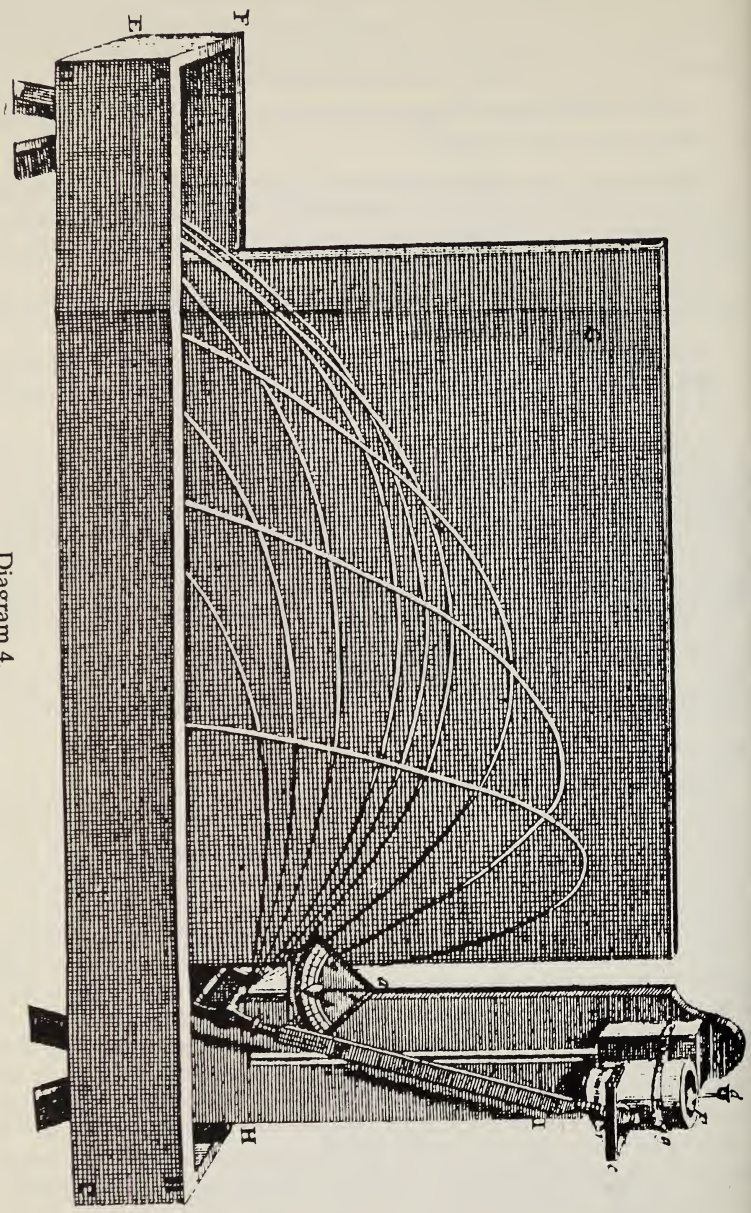

Diagram 4.

MacLaurin's reply to Crow is unfortunately lost but part of Crow's reply to that lost letter is extant[24]. From this and also from MacLaurin's extant writings on the motion of fluids it is obvious that he found Crow's result hard to accept and obviously offered some alternative thoughts to which Crow 'venture[d] to propose some objections' even though he found MacLaurin's ideas 'extremely ingenious & very intelligible'.

Nowhere in MacLaurin's extant writings has he specifically described the motion of rivers but, following the views of Sir Isaac Newton, he included a discussion of water flowing from an orifice in the *Treatise on Fluxions*[25] and about 1739 (the time of Crow's correspondence) MacLaurin started 'An Essay on the Motion of Fluids'.[26] This 'Essay' closely followed the discussion contained in the *Fluxions* but the explanation was supported by experimental data. Since MacLaurin was principally concerned with the velocity of water flowing from an orifice in a tank, he did not consider the depth of flowing water as such. Thus we cannot be absolutely sure what his thoughts were on the motion of rivers but we can see from his 'Essay' that he did not understand fully the modern conceptions of force and momentum.

MacLaurin's contemporary, Daniel Bernoulli, writing in 1738[27], avoided this problem by using the principle of conservation of energy. This principle invariably means it is easier to compare heights of water generating a velocity using the equation $v^2 = 2gh$, (where v is the velocity and h the height of the water, g being the acceleration due to gravity) than to consider the velocity itself. This equation, of course, gives Crow's theory that the velocity of the water is proportional to the square-root (or 'sub-duplicate' as Crow would have called it) of the depth. MacLaurin was very familiar with the equation in the case of freely falling bodies but he could not bring himself to apply it to the motion of fluids 'without several restrictions & explications'.[28]

One of these 'restrictions' seems to have been the consideration of friction, for Crow mentioned in his extant reply to MacLaurin's lost letter, that some experiments had changed the former's view from thinking that friction gradually diminished the water's acquired velocity until it became equable, to now believing that friction only caused some small deviation 'from the general law of motion...'.

Crow told[29] MacLaurin that an experiment he had conducted on his estate at Netherbyres had helped form his new opinion. When the flowing water in his 'great Canal' was about 18 inches deep he had made three marks 'even with the surface' – one at each end, 400 feet in length apart, and one in the middle. Crow found that when the water had fallen 8 inches at the foot of the canal, it had fallen '9 inches at the middle and 10 inches at the head'. He also pointed out that the bottom of the canal was horizontal

'... and which is still more, there is a foot of stagnant water, above the bottom, which probably does not move at all, so that there can be little friction in this case...'.

The result of this experiment, Crow concluded, was that for frictionless flow the 'velocity is directly as the depths'. In order to reinforce this theory he referred MacLaurin to Castelli's experiment[30] where

'in moving water ... the quantitys are as the squares of the depths, (and consequently, the velocitys as the depths) in a smooth wooden trough, ... placed horizontal...'.

Here indeed Crow has turned from dismissing the conclusions drawn from Castelli's experiment in his earlier letter[31] to MacLaurin as something he 'was not able to swallow', to suggesting they now supported his own apparently revised theory. Clearly something in MacLaurin's reply had unnerved Crow and we are given a hint of the cause by Crow[32]: 'I think the squares of the velocities will not obtain...'. When we realise that Crow's letter continued with a discussion of water issuing through an orifice, we can make a fairly conclusive assertion that MacLaurin, in his now lost reply to Crow's earlier letter, reaffirmed his own theory, (now known to be incorrect), given in his *Treatise on Fluxions* that the velocity of water in a cylinder is proportional to the square of the depth of the water.

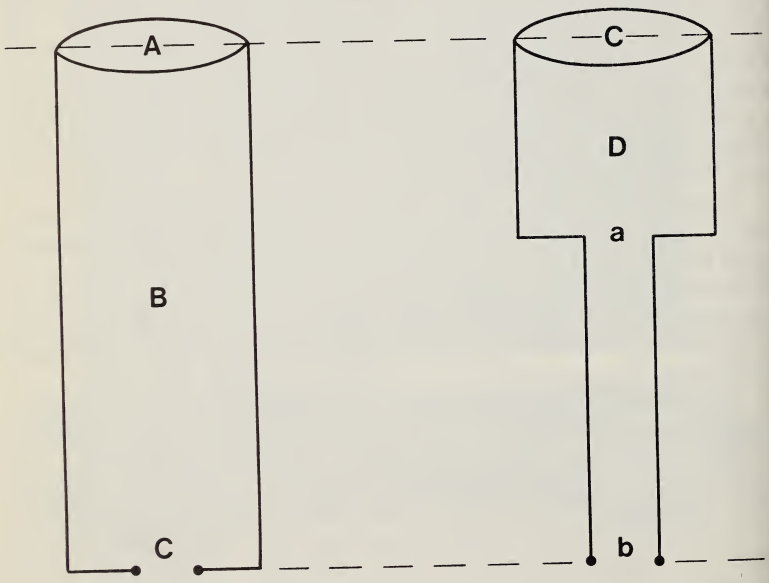

Diagram 5.

The point both Crow and MacLaurin seem to have missed in the case of the smooth horizontal canal is that the flow-rate Q, where Q = (velocity) x (cross-sectional area of the canal), is a constant and so the velocity is inversely proportional to the depth assuming the canal to be of uniform width. However, this is the formula which Crow used to obtain his answer to the problem of the ford, so it is possible that where he mentioned velocities being proportional to the depths he really meant velocities being inversely proportional to the depths, which is correct for this situation. Crow's 'great canal' can still be seen at Netherbyres and it is indicative of his careful taking of the results of his experiments that, much as he obviously would have wished, Crow could not bring himself to contradict the experimental evidence in order to agree with MacLaurin's theory.

Again Crow gave experimental results to question MacLaurin's agreement with Daniel Bernoulli's theory that the velocity of the water issuing at c in the cylinder ABc (Diagram 5) is the same as from b in the cylinder CD ab. Crow made the point that:

'when you first open the orifice (b) the water in the pipe (ab) will begin to move slower than that of the orifice (a) ... till the velocity of the water at (a) is communicated, and then ... the velocity at (b) will be increas'd, till it become a mean betwixt that of (a) and (c)'.

Although Bernoulli and MacLaurin were correct in theory, Daniel Bernoulli himself showed[33] that in practice, for a very short time initially, Crow's reasoning is correct, the mean velocity though being so near to its theoretical counterpart that after an initial second or so we can assume the theoretical result in practice.

Crow concluded his thoughts on the motion of water by mentioning he would be 'extremely glade' to see MacLaurin's 'Essay'[34], but he also made another relevant point: that by straitening the orrifice, a greater quantity of water will flow in the same time...'. In modern terminology, this sharpening of the orifice has the effect of increasing the coefficient of discharge, C_d, defined by $C_d = \frac{\text{actual discharge } Q}{\text{theoretical discharge } Q_t}$.

Since the theoretical discharge Q_t is constant increasing C_d gives a corresponding increase to the actual discharge Q. Thus once again Crow's theory worked out from his experimental results has proved to be completely compatible with modern theory.

In the few remaining manuscripts relating to the work of Crow, there is no indication whether he pursued his theory that the velocity of a flowing river is proportional to the square-root of its depth. But it is interesting to note that in MacLaurin's 'Essay', which he was writing at the time of this correspondence, we find:

'... when the water is suffered to subside in the Vessel without any new supply ... the water issues with a motion that is at first accelerated for

a finall time (imperceptible when the vessel is erect, but sensible when it is oblique & of considerable length,) till it soon comes to its greatest Velocity...'.

Of course how much of this change from purely mathematical theory to one more in keeping with practical experimentation is owing to Crow's influence, can only be speculation. But MacLaurin certainly held Crow in high esteem describing him in 1738 as being 'one of the best acquainted with mechanics I have met with in this country'.[35]

Having this opinion of Crow, MacLaurin consulted him concerning a solution to the problem of lack of fresh air about which he had received a letter[36] from Baron Clerk, one of His Majesty's Barons of the Exchequer and an M.P. at Westminster. Clerk, or to give him his proper title, Sir John Clerk of Penicuik (1676-1755), owned a number of coal mines and was concerned that when he sank a shaft 30 fathoms deep divided in the middle by a partition about an inch thick, it was necessary to either force air down by using bellows or

'by a square pipe 5 or six inches of a side, raised above the Coal pit with a Tunnel mouth turning to the wind'.

Clerk pointed out to MacLaurin that at Whitehaven in Cumbria 'they will work a pit of 120 fathoms deep when divided in the medle...'.

Crow's solution to this problem, communicated to MacLaurin in his letter[37] already discussed, suggested that as the diameter of the pipe was considerably less than the pit or level below ground:

'... the external air will rush in with violence, and force the other [stale air] to return through the wooden pipe; by which means a circulation of fresh Air will be maintain'd...'.

this theory would be verified, Crow asserted, by there being a 'constant small wind at the upper mouth of the pipe' or, should the circulation be in the contrary direction, the wind would appear 'at the lower mouth of the pipe...'.

But in 1740, the time of writing this letter, Crow's thoughts were never far from the motion of water and he continued that:

'... with all submission to better judgements, I am still persuaded, that it is possible to lay a streight pipe at any distance below water, passing thro' a glacis of Clay, [i.e., a sloping bank of clay] so as to remain as tight as any part of the bank'.

Once again, Crow was ahead of the general thinking in the first half of the eighteenth century, since this is perfectly possible.

In his lost reply to Crow's first extant letter, MacLaurin mentioned a theorem "concerning the velocity of water thro' a double cylindrical vessel, with different orrigices [sic]...'[38]. Since Crow had not seen any pages of MacLaurin's *Fluxions* even though this part was 'printed tho' not published'[39], it may be that this theorem

was essentially what is now paragraphs 549 and 550 of the *Treatise on Fluxions*. However, in the 'Essay on the Motion of Fluids', MacLaurin gave a much clearer theorem in paragraph 2, arising out of his Experiment 5, that when a thin plate or diaphragm cd is placed across the middle of a cylinder in which there is an aperture ef, the water issues from the orifice ED in the outer bottom of the cylinder with

> 'a less velocity than if the plate cd was not there nearly in the ratio of ef^2 to $ef^2 + ED^2$'.

It seems to be more likely that it was this theorem from his 'Essay...' which MacLaurin corresponded to Crow.

Whether or not MacLaurin told Crow that this experiment was first performed by Mariotte[40] cannot be definitely decided from the extant evidence but it seems likely since, firstly, as we have seen, Crow was familiar with Mariotte's *Traité...*; secondly, MacLaurin in his 'Essay...' acknowledged this experiment to Mariotte adding, however, '... that he did not assign the true cause'. Thirdly, Crow wrote in his reply[41] that:

> 'the ratio being pretty much compounded, it will be a very great confirmation of your theory, if the effect succeed in an Accurate experiment...'.

Interestingly, Daniel Bernoulli in his *Hydrodynamica*[42] gave the same result and theory as MacLaurin for Mariotte's experiment, generalising the result still further, thus justifying Crow's judgement of the members of the scientific and mathematical fraternity of his time, since Bernoulli is considered today as the founder of modern hydrodynamics.

The conclusion to Crow's letter is lost and since it was customary at this time to put the date with the valediction we have to rely on the last paragraph of the extant part accurately to date this reply. Crow mentioned that a 'long intense frost' made him prefer 'drinking a hearty bottle with my friends' to:

> '... making observations, on the phenomenon of cold; altho' indeed some accidental experiments did occur to me (particularly relating to the effects of congelation upon fermented spirituous liquors)...'.

Here then, is our clue: for another extant letter[43] of Crow, dated 5th February, 1740 and written to 'Doctor [Charles] Alstone professor of Bottany at Edenburgh', mentioned 'this long intense frost' and 'two or three accidental experiments' that had occurred when Crow's beer barrels and a saucer of brandy had 'frozen into solid ice'. Consequently, we can date Crow's reply to MacLaurin as late January 1740, thus also noting that a year elapsed for one exchange of letters between Crow and MacLaurin.

It is, of course, most likely that the delay in this correspondence was caused by the fact that MacLaurin was a very busy man. Not

only was he teaching at the University of Edinburgh, but in addition to completing his *Treatise on Fluxions*, he was also researching and preparing at this time his paper on tides which was to gain for him the 'Grand Prix' of the French Academy of Science at Paris for the year 1740. On this occasion he shared the coveted prize with Daniel Bernoulli and Leonhard Euler.

In addition, he was still one of the Secretaries of the Edinburgh Philosophical Society and as such played a major role in its day to day affairs. We know that in June 1738 William Crow addressed the monthly meeting of the Society[44] and since each member's turn at speaking only came around every 18 months or so, we have, from one of MacLaurin's manuscripts, a hint of what Crow told the meeting.

The manuscript[45] of MacLaurin is dated 'June 7, 1739' and begins:

> 'Sometime ago Mr Craw proposed a single engine that might be of use when a great weight is to be moved but a very little way, or when a great resistance is to be just overcome...'.

This manuscript is obviously at least an outline for a lecture, delivered presumably to the Edinburgh Philosophical Society, for MacLaurin continued:

> 'I shall first describe this contrivance and compute its effect then shew how it may be compounded as other engines so as to have a greater & greater force at pleasure...'.

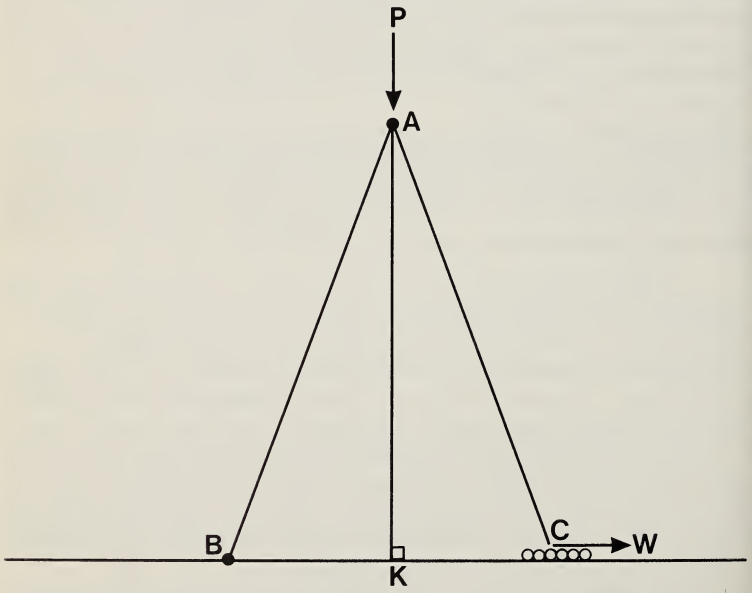

Diagram 6.

A description in words, which was supplemented with a diagram now lost, shows the machine to have been two long iron bars of equal length joined at A by means of a toggle-joint (Diagram 6). B was fixed to an immoveable object B and C rested on a smooth roller ('to diminish the friction'). The stroke of a hammer gave the 'power' P at A and this caused the end C to move the weight W.

In order to calculate the power to weight ratio, MacLaurin used the equation that efficiency (ξ) = $\frac{\text{mechanical advantage (M.A.)}}{\text{velocity ratio (V.R.)}}$.

If, with MacLaurin, we ignore friction, then $\xi = 1$ and so M.A. = V.R.

Now the mechanical advantage = $\frac{P}{W}$ and the velocity ratio = $\frac{\text{velocity of W}}{\text{velocity of P}}$. Hence we have, with MacLaurin who used this 'modern' terminology:

$$\frac{P}{W} = \frac{\text{velocity of W}}{\text{velocity of P}} = \frac{\frac{d}{dt}(BC)}{\frac{d}{dt}(AK)} \quad \text{since W}$$

acts along BC and P acts along AK.

But since Δ BAC is isosceles we have:

$'BC = 2BK = 2\sqrt{BA^2 - AK^2}$ and BA is invariable

$$[\text{so}]\ \dot{BC} = \left[\frac{d(BC)}{dt} =\right] - \frac{2AK \times \dot{AK}}{\sqrt{BA^2 - AK^2}} = -2\frac{AK \times \dot{AK}'}{BK}.$$

Here we see that MacLaurin used Newtonian fluxional notation instead of our modern Leibnizian one. Thus $\dot{AK}$ is equivalent to $\frac{d(AK)}{dt}$.

Thus for Crow's machine we have

$$\frac{P}{W} = \frac{\dot{BC}}{\dot{AK}} = -\frac{AK}{\frac{1}{2}BK}$$

so that:

'if BK be 6 feet and AK 6 inches, the power will be to the weight as 1 to 6'.

In order to compound Crow's machine, MacLaurin suggested that now C should strike the head a, of a similar machine, acb,

where b is fixed and the weight W is moved by c. The hammer still strikes at A as before. Then letting the reaction and action on C be W_1 we have:

$$\frac{P}{W_1} = \frac{BC}{AK} = -\frac{AK}{\frac{1}{2}BK}, \text{ as before,}$$

$$\text{and } \frac{W_1}{W} = -\frac{ak}{\frac{1}{2}bk}.$$

$$\text{Therefore, } \frac{P}{W_1} \times \frac{W_1}{W} = \frac{P}{W} = -\frac{AK}{\frac{1}{2}BK} \times \left(-\frac{ak}{\frac{1}{2}bk}\right)$$

$$= \frac{AK^2}{\frac{1}{4}BK^2}$$

if, as MacLaurin assumed,

'AK be to BK ... and ak be to bk in the same ratio'.

'It is obvious', MacLaurin continued, 'how this composition may be compounded at pleasure', the general result for r linkages being

$$\frac{P}{W} = \frac{AK^r}{\frac{1}{2^r}BK^r}.$$

But MacLaurin, knowing his audience included some relative experts in mining, amongst whom we may number Sir John Clerk of Pennicuik and Lord Elphinstone[46], added:

> 'But whether this might be usefull with some proper addition to the engine in digging with pointed irons into quarries or mines may be better judged by those who have experience of such Work'.

In the view of at least one present-day engineer it is only Crow's machine (i.e. the use of one linkage) which would have any practical value since increasing the force moved will decrease the distance through which it can be moved (or in modern terminology: force x distance = constant). Thus here again Crow's practical genius can be seen at work comparing very favourably with MacLaurin's more theoretical approach. It is significant that a modern pair of 'tree-loppers' has an action virtually identical with Crow's 'machine', and these tools are advertised as having a 'unique leverage'. But fluid dynamics and mechanics were not the only interests of Crow. We learn from his letter[47] of 5th February, 1740 to Alston that he was taking up again his 'old favourite study, Bottany' since his 'passion for it [was] still remaining'. The purpose of Crow's writing to Alston was to tell him of the terrible state of his

gardens. They had suffered from north winds in April 1739 which had left his plants in a 'Sickly condition' so that 'this severe frost has only given them the finishing blow'.

As this letter from Crow to Alston has been published in the History (Vol. 43, 90-92), it will suffice to mention here that Crow thought many of his plants had died, including his 'Begonia', and that his peaches ('of which I have a wall 300 feet long') had 'lost the greatest part of their small wood'. As Lt. Col. Simon Furness has pointed out to the writer, this peach-wall is in all probability a section of an elliptical garden still fully intact at Netherbyres.

The garden is marked on a plan of the estate dated 1818. As we shall see, Crow's son eventually owned Netherbyres; he died in 1813, the estate passing to his nephew. Of course, it is possible that Crow's son built the elliptical garden but in view of William Crow's known interests in horticulture and mathematical constructions, it seems much more likely that William himself designed and supervised the building of the garden. The 'handbook' of gardening in the early 18th century was *Systema Horti-culturae: or, the Art of Gardening* by J. Worlidge and this contains the suggestion that a round (circular) garden

> 'is very pleasant... The Walls about such a Garden are very good for fruit, the Wind being not so severe against a Round, as against a streight Wall'.[48]

Colonel Furness has suggested that it may have been from this book that Crow took the idea of an elliptical garden and this certainly seems an extremely plausible theory since Crow would have known that a circle is a special case of an ellipse and the mention on the winds in his letter to Alston indicates that he was concerned in reducing their effect. Furthermore the measurements of the ellipse yield the equation:

$$\frac{x^2}{162^2} + \frac{y^2}{105^2} = 1$$

Now allowing for the sun to pass from Southeast to West, which is from 9 a.m. to 6 p.m., G.M.T., the corresponding length of the wall of the ellipse running from Northwest to East will be

$$\pi \times (165 + 105) \times \frac{135}{360} \text{ feet}$$

which evaluated is 314.59 feet. This seems to correspond remarkably well with Crow's assertion to Alston that his peach-wall was 300 feet long.

Further there is at Netherbyres a line of trees which have been planted along the associated directrix (i.e., the associated fixed line) of the elliptical garden. In addition, the trees on the directrix are clearly very old, – perhaps 250 years.

In his letter to Alston, Crow asserted that

> 'I happend to prune two or three of my peach trees in November last, and I find they have suffered much less damage from the frost, than those which were not ply'd close to the wall...'.

Thus Crow observed the fact that a stone or brick wall will retain heat[49] as well, of course, as acting as a shelter from the north wind. It will be obvious from the mathematical skill of Crow that he was easily capable of carrying out such an imaginative design, but it is certainly questionable as to whether his son was so capable. We can therefore be fairly confident that Crow's 'peach-wall' is that still standing at Netherbyres.

Crow's letter to Alston continued with details of the 'accidental experiments' concerning the effects of freezing in alcoholic beverages. First, 'a barrel of small beer' (i.e. weak beer) happened to partly freeze in Crow's outer cellar. When he drew off the liquid part which was about half of the barrel, the beer 'was extremely fine, and a good deal stronger than the rest of that brewing'. Crow then thawed out the ice in the barrel to find 'the solution was altogether insipid'. The modern scientific explanation for this is that the beer contained water and alcohol and since the latter freezes (or solidifies, strictly speaking) at a much lower temperature than that of water, the alcohol became concentrated in the remaining liquid, or, as Crow put it:

> '... it seems that the spirit in the small beer fled from the ice (as from an enemy) and lodg'd itself in the center of the barrel'.

Next, Crow left 'a tea sawcer full of brandy, on the outside of a north window' and found next morning that the brandy was fully frozen into solid ice. On thawing, it 'had an acerb disagreeable taste' and would not 'flame in the fire'. Crow pointed out to Alston that had he 'been in a humour for trying such experiments', he would have weighed the brandy before and after freezing to see if 'the inflamable spirit [had] evaporated...'. Here, of course, the brandy, being a solution of alcohol and distilled water, has changed state from its stable liquid state to its solid state and in so doing a chemical change takes place and renders the alcohol 'sour'.

It is debatable, however, how much Charles Alston would have known about chemical changes and the act of preservation by freezing. He was essentially a botanist and although by 1740 he had a non-stipendary professorship at the University of Edinburgh his salaried position was that of 'King's Botanist, Professor of Botany and Materia Medica, and Overseer of the Royal Garden' in Edinburgh. This title had been granted to him by King George I in 1716 and it was confirmed on the accession of King George II in 1727. Alston was deeply influenced by the Leiden school of medicine; in particular by Boerhaave and his two pupils, Andrew Plummer and Alexander Monro, the latter not only probably being Alston's most

intimate friend[50] but also a good friend of MacLaurin too. Alston, Plummer and Monro also joined Crow and MacLaurin in being founder members of the Edinburgh Philosophical Society.[51]

Although Alston had graduated Doctor of Medicine from the University of Glasgow in 1719, his first interest was botany and so he would probably have been more interested in Crow's telling him that he had 'try'd to thaw some lemmons (which were very hard frozen)' with the result that 'the fruit remained perfectly sound, & full of good juice'. Crow tried the same experiment with potatoes only to find that on thawing 'they soon turnd... to a watery pulp...'.

Today, of course, the property of freezing in order to preserve food is in domestic use and it is common knowledge that some foods will 'freeze' while others will not. But in the 18th century, such ideas were new and we may again marvel at the scientific vision that William Crow had. We may certainly claim that he was amongst the first to consider the preservation of certain foods by freezing.

Any other correspondence between Alston and Crow is lost but there is an extant letter[52], dated 7th June 1740, which is a reply from Crow to a lost letter from Lord Morton. That Crow's knowledge of hydrodynamics was well known is indicated by the fact that Morton had, in his lost letter to Crow, asked him about a 'Regulator pipe' for his mill. From this letter[53] we learn that Crow had at Netherbyres a reservoir in which he had a lead pipe with a cylindrical joint, which was 'now beginning to fail' having been laid 'above a dozen of years'.

However, Crow felt that this type of joint would be unsuitable for 'a large pipe of 7 or 8 inches diameter, such as a mill-dam will require'. Instead , he proposed a new joint, which would 'last a life time, raise the pipe to any angle, and ... easily be adapted to one of any size'. The 'first hint' of this improved joint he had received from Lord Minto and it seemed it was 'a real improvement of the Machine'.

Unfortunately for us today, Crow, instead of writing a description in the letter, sent a 'model with its explanation' which he hoped would 'make everything very intelligible'. Thus, since the model and its 'explanation' are no longer extant, we cannot even really speculate on what the new regulator was like.

However, Crow promised Lord Morton he would make a visit to him at Aberdour (in Fife) going via Stirling Bridge 'to shun the Sea passage, which is the only Water work I have an Aversion to'. But first he had to finish 'erecting an old fashion'd and perhaps useless Machine, called a Kirk' not because he was:

> 'an undertaker by way of profit, but purely to oblige my neihbours [sic], by expending their money frugally, and at the same time making a handsome church'.

It would appear from *Fasti* that the Church which Crow was

rebuilding was the Parish Kirk at Ayton.

From this letter of 7th June, 1740 we also learn that in the 18th century, just as in the 20th century, it was not uncommon for a severe winter to be followed by a dry summer, for, according to Crow, June 1740 'call[ed] for the utmost frugality in dispensing of water'. We will recall that Crow's letter to Alston was dated February 1740 and mentioned 'severe frosts'.

The last known extant letter[54] from Crow is dated 13th March 1742 and is an acknowledgment of a letter dated 4th March from MacLaurin. Since MacLaurin had:

> 'unluckily directed to the care of the postmaster of Ayton, where there happens to be neither post house or postmaster',

Crow only received the letter on 12th March. Instead, MacLaurin should have directed the letter to "Berwick, for at Ayton":

> 'the post boy gives the letters out of his pocket to an old drunken wife, who frequently never delivers them at all'.

Although this letter of Crow is polite and friendly, it does not contain the depth of mathematical and scientific discussion that Crow's earlier letters to MacLaurin do. MacLaurin had been observing a comet which was possibly making a re-appearance and Crow's humour linked this to the politics of the day:

> 'Had the Judicial Astrologers flourished in this Age, they wou'd surely have termed this as a Patriot Comet, & to its rise, have attributed Sir Roberts {Walpole's] down fall. if its Tail shou'd grow a little longer, God have mercy on the old Cardinal! [Alberoni, who contributed to Walpole's downfall by encouraging war with Spain]'.

MacLaurin too had told Crow about his 'deduction' concerning the best position of the 'Saills of a Windmill' but he clearly did not give any details for Crow:

> 'long[ed] to see your deduction ... which I find will agree pretty near with Monsieur Mariotts Doctrine, who makes the angle of Inclination 60 degrees'.[55]

This comment by Crow, written in 1742, is interesting for it suggests that MacLaurin had had fresh thoughts about the mathematics concerning the position of the sails of a windmill. In his *Treatise on Fluxions* (paragraph 914) and also in his *Account of Sir Isaac Newton's Philosophical Discoveries*, published posthumously in 1748[56], MacLaurin showed that 'the most advantageous position of the sail' should be 54° 44' but qualified this result by adding that 54° 44':

> 'is the most advantageous angle only at the beginning of the motion of the engine; so that the sails of a common windmill ought to be so situated, that the wind may indeed strike them in a greater angle than that of 54° 44''.[57]

This then, was the new result that MacLaurin corresponded to Crow in 1742, the year in which his fluxions was published. The 'deduction' which Crow did not see, at least at this time, reasoned that:

> 'when any part of the engine has acquired the velocity c, the effort of the wind upon that part will be greatest, when the tangent of the angle in which the wind strikes it is to the radius... as $\sqrt{2+\frac{9cc}{4aa}}+\frac{3c}{2a}$ to 1, the velocity of the wind being represented by a.'[58]

This modified result yields the angle as 63° 26', if $c=\frac{1}{3}a$ and 74° 19', if c = a – an important result, 'because, in this engine', MacLaurin continued:

> 'the velocity of the parts of the sail remote from the axis, bear a considerable proportion to the velocity of the wind, and perhaps sometimes are equal to it...'.[59]

This deduction, taken from *Newton's Philosophical Discoveries*, has more clarity than the corresponding section in MacLaurin's *Fluxions*. Indeed, the paragraph in the *Fluxions* only mentioned 'a celebrated author' who made a similar calculation incorrectly; but it is from *Newton's Philosophical Discoveries* that we learn that MacLaurin had been reading Daniel Bernoulli's *Hydrodynamica* and had found a mistake in Bernoulli's calculation which yielded an incorrect answer. However, Bernoulli made the point,[60] not clearly expressed by MacLaurin, that the velocity of each point on the arm of a mill is different:

> 'in different locations on the arms; they are, indeed, proportional to the distances from the center'.[61]

Furthermore, Bernoulli added that:

> '... indeed, I have often observed on mills that the tips of the arms are carried at a velocity which almost equals the velocity of the wind itself'.[62]

Thus it would seem that the result which MacLaurin corresponded to Crow owed at least some of its thought to Daniel Bernoulli's *Hydrodynamica*, and does indeed, as Crow found, agree in principle with that of Mariotte, who asserted that an angle of 60° was the best value when the various forces on the arm of the mill are considered simultaneously.[63]

From Crow's last extant letter[64], we also learn that he had spent the winter making a model of a 'close chaise, or rather a two wheell'd Chariot, drawn by a pair of horses abreast...'. This 'Chariot' could hardly be overturned and being of 'no weight on the horses backs', could, therefore, 'be drawn with the greatest ease possible'. In order to make the ride very smooth Crow supported 'its center of Gravity ... with Six Ashen springs'. Having, at the time

of writing, finished his model, he intended 'to make the Machine at full growth, for the use of my wife, this Summer'. Crow added that if the chaise were a success then he would recommend 'one of them for M^rs^. Mac Laurin...'.

Thus ends the extant correspondence of Crow, but it is interesting to note that Robert Kerr[65], in a book published in 1809, credited Crow with being the inventor of the Thrashing (or threshing) Mill, which separates grain from the straw, the moving power in the 18th century being generated by horses, oxen, wind or water. The invention of the machine, in 1758, has been credited to Michael Stirling, a farmer in Perthshire, basic improvements being made by Andrew Meikle about 1776. However, according to Kerr, 'many years before ... Muckle', Crow had 'constructed a working model of a thrashing mill' which

> 'consisted of a series of flails or swipes moved by machinery; which was found tolerably efficient, but dangerous to approach, and very liable to break'.

There is no doubt that Crow was quite capable of designing and building such a machine and since he died in 1750, there is some justification for claiming that Crow was the inventor of the threshing-mill even though, as Kerr remarked, Crow's machine was built 'upon quite different principles' to those of Meikle.

Another of Crow's and MacLaurin's mutual friends was the Rev. George Mark, who for some years was Episcopalian Minister at Dunbar. He carried out some experiments on the motion of water in the great canal in the Duke of Roxburgh's gardens at Broxmouth, near Dunbar, as well as others at the mill at West Barns, near Dunbar. There is no evidence that Crow and Mark exchanged results, or even had any correspondence, but that they did know each other is illustrated by a postscript to a letter[66] from Mark to MacLaurin. In 1743, Mark left Dunbar to teach and preach in Dundee and his letter, dated 5th May, 1744, to MacLaurin concluded with the remark:

> 'Pray how does our friend M^r^ Crow of Netherbyres'.

MacLaurin's reply to Mark is lost and today there is no extant evidence of anything Crow did from 1742 until 1745, when by a Sasine[67] dated 15th February 1745, he sold a piece of waste ground on the north of Eyemouth to William Nisbet, a merchant in Eyemouth. On the same day Crow assigned to William Nisbet, and to John Nisbet, a merchant in Dunbar, a heritable bond dated 10th May 1733, for £50 given then by David Nisbet, a merchant in Dunbar.[68]

During 1747, Crow was busy planning and later building what was to become known as the Old Pier in Eyemouth. The cost was met by private subscription and it was so designed that it prevented the gravel from the beach silting up the mouth of the river Eye.

Because of this, the harbour was able to accommodate coasting vessels of a considerable size; and it allowed farmers to dispatch their surplus produce by sea directly from Eyemouth rather than from Berwick upon Tweed; or having to use land conveyance. Certainly, an expert architect dates the warehouses on the quay at Eyemouth from this time of expansion in sea-trade. As Kerr[69] pointed out, the elbow of Crow's pier collapsed in a great flood of the River Eye in 1766.

Perhaps it was to pay for this pier that Crow in 1747 exchanged a heritable bond of £240 Scots with John Wilson, a mason in Eyemouth, Crow conveying for the bond a piece of ground on which Wilson had built and repaired a cottage[70]. However, it is more likely that Wilson received the cottage and land as a payment in kind for his completed work on the cottage.

William Crow died on 26th February 1750 and was buried in the churchyard of Coldingham Priory on 1st March 1750[71] his 'mort cloth' being made in Eyemouth. His wife, Margaret Allan, sister of the then minister of the Church of Scotland at Eyemouth, erected a fine white marble tombstone which during the 19th century became very damaged but which has now been restored by the generosity of Colonel Furness. From the Latin inscription[72] on the marble we learn that Crow, who also had an interest in music, besides mathematics, died suddenly of a palsy:

H [ic] S [epultus]. E [st].

Guiliemus Crow de Netherbyres, armiger,
Qui ad artem quamque vero ingenis dignam.
Percipiendam pariter (ac or acque) colendam
Ingenio valebat nobilis (simo)
Quod prae ceteres d(iligenter) exercuit
Musica, Mechanica, h(umana)rum cultura
Quarum ac cognalaru(m) (a)rtium peritia
Cum nonestate illibata ac m(o)ribus urbanis conjuncta
Principibus haud panas in republica et in literis viris
Et notus et meritissimo carus factus est,
Optimorum aulem amicitias parcus colens,
Amicum potius praebebat generis humani
Familiarum ac totius viciniae commodus
Consilio prudenti, opere indefesso,
Libentissime semper inserviendus
Vitam agebat paterno rure
Fucuelates modicas sapienter administrans
Elegenter simul iis-dem fructus,
Contemptor lucri, ambitione major,
Libertatis amantissimus
Dum praestanti cuique stud(is) nobile incumbit
Valetudini suae ac viribus (animae) parsim consuelens
Mediae aetatis ha(ud) (tant)um inclinatus
Resolvit nervorum cor(ruptus) brevi extinctus est
Obiit 26th Februarii A.D. MDCCL

Annos nat(us) 2 m(enses)
Hoc Saxum Nugus memor(iae) sacrum
(Margaret Allan) uxore moestissima
(Erectum est).'

Translated:

'Here is buried William Crow of Netherbyres, Esquire, who, alike in acquiring and cultivating every science worthy of an ingenious man, exalted by a most noble genius which he assiduously exercised beyond others. By music, mechanics, the culture of letters and skill in these and other cognate arts, combined with thorough integrity and elegant manners, he became known and was deservedly dear to not a few of the chief men of the state and of literature. Sparingly cultivating the friendship of the great, he rather showed himself to be the friend of the human race. He always cheerfully devoted himself to the benefit of his acquaintances of the whole neighbourhood, by prudent counsel and by indefatigable exertion, he spent his life on his paternal estate, wisely administering his moderate means and at the same time elegantly enjoying them. He was a despiser of lucre, and a most ardent friend of liberty. Superior to ambition, whilst he eagerly gave himself to every noble study not considering his own health or strength, in the mid-time of his days, seized with palsy, he was suddenly cut off. He died on the 26th February in the year 1750, aged years, 2 months.

This stone, sacred to his memory, is erected by his deeply affected wife Margaret Allan.'

It is most unfortunate that his age in years is omitted, but we do learn that he was born in December and since his father's will is dated 10th February, 1704 and this, we may assume, would be in the Old Style, in which the New Year began in March, we can surmise with some confidence that William was born in December, 1704. This well satisfies all the extant evidence and would make him 46 year old when he died (strangely at the same age and from the same cause as his friend MacLaurin).

Crow died intestate, but the customary Testament Dative and Inventory[73] was made and certified by his wife, and on behalf of his daughters, Margaret, Sarah, Mary and Elizabeth who were all minors in 1751. William's nett balance was £50 sterling according to this Testament but in 1757 an eik was added, indicating that his wife had discovered further debts owing to her late husband, totalling over £25. Her brother, Rev. James Allan, acted as a Cautioner.

From the original Inventory of 1751 we can obtain a relatively

detailed plan of the house which was owned by Crow. Downstairs, above a cellar, was a hall, kitchen, dining-room and another reception room. Upstairs there were three bedrooms, one known as 'Leigh bed Chamber', a bedroom above the dining-room and 'Mistris Crows Bed Chamber'. In the roof or 'Garret', Crow had kept his 'Pistolls', an old silver-hilted sword and a Cutlass. The most valuable single item listed was for £10 sterling and consisted of Crow's 'Books and Manecall [Mechanical] Instruments'.

Thus Crow lived in relative simplicity and quietness, without amassing a fortune or living destitute. Certainly his father's wishes, that he be spared the labours of farming were carried out and one can only imagine that George Craw would have been exceedingly proud of his son's achievements. Not only did William keep the estate in order but he used his position to further scientific thought far beyond that which his contemporaries could appreciate. The most obvious of his discoveries in this respect was his observation on the possibilities of preserving certain foods by freezing; but many of his other thoughts were ahead of his time. His work on the theory of motion of rivers was not accepted without questioning by probably Britain's, and certainly Scotland's, most outstanding post-Newtonian mathematician, MacLaurin. But it is Crow's theory which is in keeping with our modern knowledge. Again, his ability to invent mechanical 'contrivances' led to a threshing or thrashing machine some years before the now accepted inventor put his machine to a demonstration.

However, the finest example of his applying pure mathematics in a practical way was probably conceiving and constructing the elliptical garden, complete with a row of trees as the directrix. It is fitting that this memorial should have stood the test of time and still be at Netherbyres today.

But, we may ask, if Crow was so inventive and had such an imaginative mind, why are his discoveries not better known, so giving him credit for his inventions? The answer seems to be two-fold:

Firstly, Netherbyres was rather remote from Edinburgh, the nearest city of learning, and although Crow was a founder member of the Philosophical Society of Edinburgh and attended its meetings, there were few who could carry out his ideas from his workplace to the city. Indeed it is probably because he worked in isolation, relatively uninfluenced by current academic theory, that he was able to make the discoveries which modern knowledge has proved to be correct. As he wrote[74] to MacLaurin in 1740,

> '...there is no mortal in this country who has the least curiosity for natural enquirys...'.

Secondly, he never published any of his work, being content to address the Edinburgh Philosophical Society but not actually to contribute any written papers to the volumes that the Society and

its successors later published. Thus, while his mechanical ability was known by the members of the Society, as is illustrated by Lord Morton's consulting Crow about his reservoir, Crow's work was not known even south of the border in England, and certainly not further afield in Europe. MacLaurin certainly tried, in a small way to promote Crow's ideas, but his own work was so influenced by Newton's thoughts that he could not always accept the truth of Crow's theories and therefore was reluctant to use his position to further Crow's recognition. The theory of the motion of rivers is a prime example of this inhibition by MacLaurin.

Thus today, and only through books such as that by Kerr, A. Thomson and McIver[75], Crow is remembered simply for a generous act of citizenship in building the pier, and modifying the harbour, at Eyemouth. Generations of citizens of Eyemouth have reason to be grateful to him for this work; but it is time for a wider world to follow the people of Eyemouth in recognising Crow, not only as a generous citizen but also as a significant forerunner in the beginnings, particularly in Britain, of the theory of hydrodynamics. In addition, his ability to apply his mathematics to the world around him ought to have ensured him a significant place in the history of the Scottish pre-Enlightenment. In this respect, it is worth remembering that, in the next generation, the Parish of Ayton saw the activities of the great engineer William Smeaton.

When Crow died in 1750, his wife took possession of Netherbyres and continued to live there with her daughters, while John Mow of Mains was a superior of the estate. However, on 12th May, 1762, John Mow granted 'his' lands to George Crow who attested to be William's son[76]. George, 'of lawfull Age', successfully claimed the estate of Netherbyres together with the lands of Redhall and Billieland. The Court of the Quarter-Sessions ordered a plan of the boundaries of the lands to be drawn.

A year later, on 26th May, 1763, Margaret, George's sister, married John Mow, with her mother's consent[77]. They presumably lived at East Mains, Chirnside, where John owned a farm.

By 1771, George and his mother, William's wife, had reached an agreement by which George, now living at Netherbyres and acknowledged by Margaret Crow (née Allan) as her son, granted to his mother a heritable bond of £20 sterling in return for her renouncing her Terce over the lands and estates of Netherbyres, Redhall, and nether Ayton with the waulk mill and pertinents lying in the parish of Ayton. She also agreed to renounce all her rents and 'other Heritage' that 'pertained to the said William Crow, my husband'. All this was agreed on 1st June 1771 at a meeting at Netherbyres before Thomas Cockburn, W.S., at which John Mow, his wife Margaret, and James Henderson, a merchant in Eyemouth, were also present.

On 24th June, 1771, the Sasine[78] was duly registered by George

Crow, that in addition to the bond above, he would pay his mother twice yearly, at Martinmas and Whit Sunday, £45 sterling in return for his mother's complete renunciation of all her heritage from her husband. It is perhaps worth remembering that nearly 70 years previously, William's father made provision in his Will for William to pay his mother 400 merks or £22.22 sterling annually. Inflation during the 18th century was minimal.

This agreed, George Crow continued at Netherbyres until his death in 1813. He never married and his burial entry in the Burial Register of Ayton Parish simply reads

> 'death. Dec^r 19 [1813] To Mortcloth George Crow. 5 (s.h.)'.

He, like his father, died intestate and the Barons of the Exchequer granted Netherbyres and Crow's other holdings to his nephew William Molle, W.S., son of George's sister Elizabeth. Should William die without issue, then the estate was to pass to his brother George, a 'Lieutenant Colonel of the Forty Sixth Regiment, and Lieutenant Governor of New South Wales'.[79]

Since the burial registers for the Parish of Ayton are only extant from 1800, we do not know when Margaret Allan, William's wife, died. It is unfortunate that it took a legal dispute to leave George's name extant and one must wonder why William's wife claimed Netherbyres and William's other lands in 1751 knowing that she had a son to whom they rightfully belonged. We know nothing else of her character but should add that the Parish Records of Eyemouth show her brother to have been one of those over-zealous ministers of the Kirk that the Church of Scotland was later to regret having amongst its clergy. Perhaps it is not a coincidence that George's mother agreed terms of settlement with her son some four years after the death of her brother, on 7th May, 1767.

However, had William Crow only made a Will and shown some of the ambitious caring of his father, perhaps much of the antagonism would have been avoided. But evidence is really too scanty to draw any further definite conclusions to this unhappy sequel to William's death.

Thus in 1813, the direct line of this branch of the Crow family ceased and Netherbyres passed to George's nephew. William Crow will thus always be the best known of this branch of the family for not only was he a public-spirited person, caring for his neighbours, but he also possessed an outstanding gift of being able to apply mathematics to some of the practical problems of the world of the pre-Enlightenment. As such, he should be remembered not only for his building the pier at Eyemouth and the Parish Church at Ayton, but also for advancing scientific theories in hydrodynamics and mechanics which have proved to be of use in the world today.

ACKNOWLEDGEMENTS

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REFERENCES

1. A. Thomson. (1908) *Coldingham Parish and Priory*. Galashiels: Craighead Brothers. Chapter 12.
2. Scottish Record Office: Reference CC15/5/7.
3. 1 merk was equivalent to nearly 6 pence of modern coinage.
4. Scottish Record Office: Reference RS19/7.
5. i.e. Scottish Record Office: Reference CC15/5/7.
6. Scottish Record Office: Reference RS19/10.
7. Scottish Record Office: Reference RS68/1.
8. See S. Mills. (1982), *The Collected Letters of Colin MacLaurin*. Nantwich: Shiva Publishing.
9. See S. Mills, [8], Letter 48.
10. For a fuller account of MacLaurin's comments, see S. Mills, [8], Letter 208.
11. S. Mills, [8], Letter 169.
12. M. Mariotte, *Traité du Movement des Eaux et des Autres Fluides*. (Paris, 1686).
13. W. J. 's Gravesande, *Physices Elementa Mathematica, Experimentis Confirmata, Sive Introductio ad Philosophiam*. (London, 1720).
14. This quotation is from Crow's letter.
15. B. Castelli, *Della Misura Dell' Acque Correnti*. (Rome, 1628 and 1642).
16. T. Salusbury, *Mathematical Collections and Translations*. (London, 1661).
17. This and the following quotations from Castelli's book are taken from the English translation by Salusbury. [16].
18. In S. Mills, [8], Letter 169.
19. Theorem 2, Book 2 of Castelli, *ibid.*, The quotation is from Salusbury, *ibid.*
20. This experiment is described in S. Mills, [8], Letter 169.
21. In his letter of 26th February, 1739.
22. This is a reference to differential calculus, a 'fluxion' being the rate of change of a variable, or in modern notation $\frac{ds}{dt}$, for example.
23. J. T. Desaguliers, (trans.), *Mathematical Elements of Natural Philosophy, confirm'd by Experiments: Or an Introduction to Sir Isaac Newton's Philosophy*. (London, 1720-1721).
24. Published in S. Mills, [8], Letter 209.
25. C. MacLaurin, *A Treatise on Fluxions*, 2 vols. (Edinburgh, 1742).
26. C. MacLaurin, An Essay on the Motion of Fluids', part of MS.208 in Aberdeen University Library.
27. D. Bernoulli, *Hydrodynamica, sive de Viribus et Motibus Fluidorum Commentarii*, (Strasbourg, 1738). The English translation by T. Carmody and H. Kobus (New York, 1968) has been used here.
28. Taken from [26].
29. In S. Mills, [8], Letter 209.
30. Given in Corollary 2 to Theorem 2, of Book 2 of B. Castelli, *ibid.*
31. I. e., his letter of 26th February, 1739.
32. In Letter 209 of S. Mills, [8].
33. In Corollary 2 to Scholium 4 of Chapter V of *Hydrodynamica*...
34. I.e. [26].
35. From S. Mills, [8], page 293.
36. Letter 172 in S. Mills, [8].
37. I.e. Letter 209 of S. Mills, [8].
38. This is apparent from Letter 209, S. Mills, [8].
39. From MS.208, Aberdeen University Library.
40. In his *Traité du Movement des Eaux* ..., Part IV, Discourse I.
41. I.e. Letter 209 of S. Mills,[8].
42. In the discussion following the Corollary to Scholium 2, Chapter 8.

43. MS. La. III. 375 in Edinburgh University Library.
44. See S. Mills, [8], page 293.
45. MS 206. 52 in Aberdeen University Library.
46. See, for example, S. Mills, [8], Letters 48 and 154.
47. I.e. MS. La. III. 375 in Edinburgh University Library.
48. J. Worlidge, *Systema Horti-culturæ: or. The Art of Gardening.* (London, 1682), page 16.
49. This fact is also observed, though somewhat more vaguely, in Worlidge, *ibid.*, pages 21-22.
50. For a more detailed account of Alston's life and work, see Chapter 5 of H. R. Fletcher and W. H. Brown, *The Royal Botanic Garden Edinburgh 1670-1970.* (Edinburgh, 1970).
51. See S. Mills, [8], Letter 48.
52. Scottish Record Office: Reference GD150/3483/6.
53. I.e. Crow's reply [52].
54. Published in S. Mills, [8], as Letter 186.
55. For Mariotte's working see M. Mariotte, *Traité du Movement des Eaux et des Autres Fluides*, 2nd Part, 3rd Discourse. (Paris, 1686).
56. C. MacLaurin, *An Account of Sir Isaac Newton's Philosophical Discoveries, in Four Books.* (London, 1748).
57. Taken from [56], Book II, Chapter 3.
58. From [56].
59. From [56].
60. In D. Bernoulli, *Hydrodynamica* ... (i.e. [27]), Chapter 9, paragraphs 38-40.
61. D. Bernoulli, [27], Chapter 9. paragraph 40.
62. D. Bernoulli, [27], Chapter 9. paragraph 38.
63. See [55].
64. I.e., Letter 186 in S. Mills, [8].
65. R. Kerr, *A General View of the Agriculture of the County of Berwick.* (1809).
66. Letter 197 in S. Mills, [8].
67. Scottish Record Office: Reference RS 19/12., f.158-161.
68. Scottish Record Office: Reference RS 19/12., f.161-163.
69. In [65].
70. Scottish Record Office: Reference RS 19/12., f.394-395.
71. Coldingham Parish Burial Records: Reference ORP 732/3.
72. A transcription is in A. Thomson, [1].
73. Scottish Record Office: Reference cc15/5/10.
74. From Letter 209, S. Mills, [8].
75. D. MacIver (1906), *An Old-Time Fishing Town: Eyemouth*... Greenock.
76. Scottish Record Office: Reference RS 19/14., f.398-399.
77. Scottish Record Office: Reference RS 19/14., f.446-448.
78. Scottish Record Office: Reference RS 19/16., f.89-91.
79. Scottish Record Office: Reference SIG 2/61, f.390-392.

THE ANGLO-SAXON INSCRIBED STONE FROM COLDINGHAM

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The stone[1] was found in April 1973 during excavation to the east of the Chapter House of Coldingham Priory and was described briefly in the excavation report[2]. It is now kept in the Priory vestry.

Description

The stone is a slab measuring *c.* 31 x *c.* 29 x *c.* 4.5 cm. The text is incised on one edge of the stone. With the exception of this edge, which is dressed, the faces and edges of the stone are all rather deteriorated. There is no sign of any carving on the stone although some could have been lost with the crumbling of the surfaces. The text is incised without margins in letters which vary in height between 2.5 and 3 cm, with the cross measuring 3.8 cm in height. The space after the cross indicates that what remains is the end of part of the text. One or more of the outer edges, perhaps to the left of the inscribed edge, may originally have contained text.

The state of the two faces suggested to Noble that the inscription might represent secondary usage of the stone[3]. Although this is a possibility, the present poor condition of the stone makes certainty difficult. The placing of the text on the edge, not on the face, of the stone does not in itself imply secondary usage. Such positioning of texts, although unusual, can be paralleled amongst Anglo-Saxon inscribed stones, for example the stone from Newent and one of the stones from Winchester[4].

Text

The text now reads[5]:

– [A]BBAD/ISSA+ |

that is, – [A]BBADISSA +, ' – the Abbess +'. It is likely that at least a personal name, perhaps more, has been lost. Such a text might perhaps have been memorial in nature.

The Latin word *abbátissa* 'abbess', appears in Old English as *abbodesse, abbadisse,* etc. with several variant spellings of the second and third vowels. The medial D suggests that the form on the stone is Old English rather than Latin. In Old English, this noun is declined as a weak feminine, that is, the nominative singular ends in *-e* and many of the oblique cases end in an *-an*. The final A on the stone could represent an inflexion in either *-e* or *-an,* showing confusion of unstressed vowels, or confusion with the loss of *-n;* such forms are found in some Old English manuscript texts, notably those in the late Northumbrian dialect[6]. ABBADISSA could therefore be explained in various ways. It could, for example, be a

nominative form, singular or plural, with a personal name or names lost; 2 it would then mean 'Abbess(es) [...]'. Another possibility could be that it represented a dative singular form following a preposition like *æfter;* it would then mean '[in memory of] Abbess [...]'. Old English *æfter* 'in memory of' occurs on various Anglo-Saxon inscribed stones[7]. These do not exhaust the possibilities.

Script

The script of the text is known as 'Anglo Saxon capitals', the script most commonly employed in Anglo-Saxon inscriptions[8]. One of the characteristics of Anglo-Saxon capitals is the occurrence of a few insular (lower-case) letter-forms in an otherwise capital text; another is inconsistency of letter-form and a third is the use of seriffing. These three features can all be observed in the Coldingham text: B and D are insular in form while the other letters are capitals; variant forms of both A and S occur; there is consistent use of careful seriffing.

Some of these features are also to be found in the display scripts of early Anglo-Saxon manuscripts. A few insular letters in a predominantly capital script can occur in these manuscripts, although less frequently than on stones; seriffing of letters can also be found. The use of variant forms of the same letter in the same word is not, however, a feature of such manuscript texts.

There are two particularly interesting letter-forms on the stone. The first is the occurrence of insular B with a loop at the top of the upright. This is a feature more common in manuscript than in epigraphic texts, but it does occur on one of the Anglo-Saxon inscribed stones from Carlisle[9]. The other interesting form is insular D with a triangular base, pointed at the bottom. The horizontal top line of this D, and its ligature with I, are features found elsewhere. Insular D with a horizontal top line but a rectangular base is a reasonably close parallel: this occurs on one of the Lindisfarne stones[10]. Other letters, which are usually rounded or rectangular at the bottom, do occur infrequently with a triangular base, for example O and G[11].

According to Noble, Cramp suggested that the style of the script of the Coldingham stone 'looks as though it is copying rather untidily a manuscript, and was not carved by someone who was very familiar with lapidary work'[12]. In my view, the script, in comparison with many inscriptions, is in fact carefully executed; as indicated above, it is entirely in accordance with epigraphic practice and I can find no evidence for its being a copy of a manuscript.

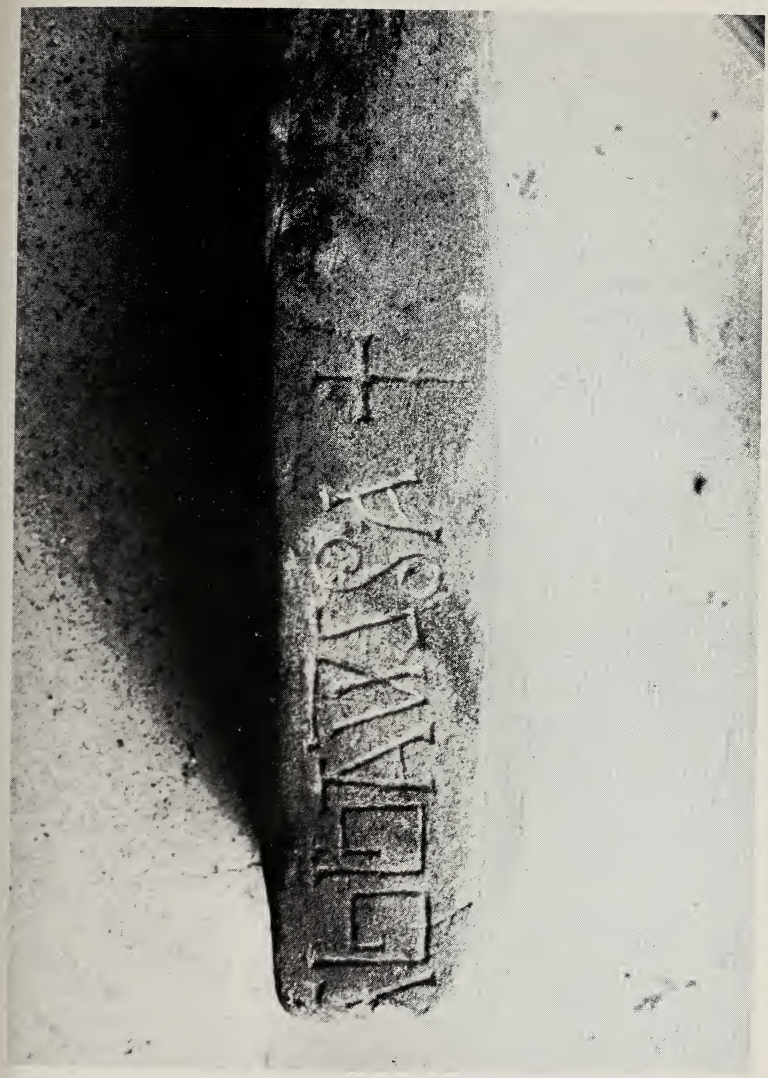
Date

There is no archaeological, historical or art-historical evidence for dating the inscribed stone. The language of the text gives no clue towards dating beyond a general indication of the Anglo-Saxon

period. The only dating evidence thus comes from the script, but dating Anglo-Saxon inscriptions by script alone is unreliable and the script cannot do more than indicate a possible date-range[13]. On the Coldingham stone, the use of angular S, and of insular B and D, tentatively suggests an early date, perhaps in the eighth or ninth century.

NOTES AND REFERENCES

1. I am most grateful to Mr. T. D. Thomson, past-President of the Berwickshire Naturalists' Club, for arranging for my examination of the stone and for his help in various ways since. I should also like to thank Mr. J. C. Higgitt, Department of Fine Art, University of Edinburgh, for bringing the stone to my attention.
2. Noble, D. (1973) Coldingham Priory Excavations, IX. *History of the Berwickshire Naturalists' Club*, 39, 176-179, and Plate 5.
3. Noble (1973), pp. 177-78.
4. Okasha, E. (1971) Hand-list of Anglo-Saxon Non-runic Inscriptions. Cambridge: Cambridge University Press. Newent – No 94, pp. 102-103 & figs.; Winchester III – No 140, pp. 127-128 & fig.
5. The following system of transliteration is used: 'A' indicates a clearly legible letter A; 'A̲' indicates a letter damaged but legible; '[A̲]' indicates a letter where the restoration is fairly certain; '/' indicates two ligatured letters; '|' indicates the end of a line of text; '-' indicates complete loss of text.
6. Campbell, A. (1959) Old English Grammar. Oxford: Oxford University Press. Paragraphs 617, 379 and note.
7. For example, the stones from Dewsbury, Falstone, Wycliffe and Yarm. See Okasha (1971), respectively: No. 30, pp. 65-6 & fig.; No. 39, pp. 71-2 & fig.; No. 144, pp. 129-30 & fig.; No. 145, p. 130 & fig.
8. See Okasha, E. (1968) The non-runic scripts of Anglo-Saxon Inscriptions. Transactions of the Cambridge Bibliographical Society, 4, 321-338.
9. Carlisle II. See Okasha (1971): No 24, pp. 61-62 & fig. This stone, which was lost in 1971, has been recovered and is in the Carlisle Museum and Art Gallery, No. 2-1912.
10. Lindisfarne X. See Okasha (1971): No. 83, p. 97 and fig.
11. See the tables in Okasha (1968) pp. 321-38. While O with a triangular base is relatively common, G is rare. An example occurs on Lindisfarne II: Okasha (1971) No. 76, pp. 94-5 & fig.
12. Noble (1973) p. 177.
13. See Okasha (1968) p. 338.
14. Reproduced from Noble, D. (1973) Coldingham Priory excavations, IX. *History of the Berwickshire Naturalists' Club*, 39, 176-170.



The inscribed stone from Coldingham.[14]

TENNANT'S PIPE FACTORY, TWEEDMOUTH

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Yardheads, Tweedmouth, Berwick upon Tweed

The modern pursuit of Industrial Archaeology has prompted me to investigate the history of the Tennant's Pipe Works, before all trace is lost. It existed for at least sixty-five years. Its increasing success and final decline mirror the social patterns associated with the smoking of clay pipes during that period.

The factory was situated behind property in Main Street, Tweedmouth, near Low Gate (Fig. 1). The Tennant family believed that clay pipes had been manufactured on the site for nearly 100 years before 1915 and that Charles Tennant purchased the good-will of the business round about 1844.

There is an article on 'Tennant's Pipe Works' in the *Berwick Journal* for 16th October 1884[1] which provides information as to the start of the factory and to its state at that time. According to this article: "It is more than half a century since pipe-making was [began as] one of the industries of Tweedmouth. At first the manufacture of pipes was carried on in a very small scale." This statement would date the start of pipe-making to the 1830s. We do not know who the pipe-maker was then; there is no record, in Lists of Tradesmen, of a pipe-maker in Tweedmouth in the 1830s. In the Tweedmouth Parish Register[2] there is the record of the baptism, on 9th March 1845, of Campbell, daughter of John and Isabella Stuart of Tweedmouth, pipe-maker. Maybe John Stuart was the man from whom Charles Tennant is reported *(vide supra)* to have purchased the good-will of the business in 1844. There is no record of a John Stuart as a resident of Tweedmouth in a Directory for 1834.

There is a record of the baptism in 1847 of a child of John Davies, pipe-maker[2], but he was born in Scotland and the 1851 Census shows that he only arrived in Tweedmouth after 1845. He was presumably a journeyman pipe-maker, one of Charles Tennant's first employees. The same man was still employed in 1871, and was by then joined at work by his wife. Thus, from documentary evidence, we are only justified in stating that pipes were being made in Tweedmouth by 1845.

Charles Tennant was born in Edinburgh in 1805 and by 1837 was working in Tweedmouth as a painter and glazier. He married Mary Forster, a dressmaker and daughter of a blacksmith, Robert Forster. According to the electoral register of 1843/4, she was a grocer, her husband still a glazier, and they lived in the house and shop on the corner of Kiln Hill, No 84 Main Street, Tweedmouth. There is a right of way at the side of these premises leading up to the land on which the factory developed (Fig. 1).

Until 1840 or so, the making of clay pipes was a cottage industry

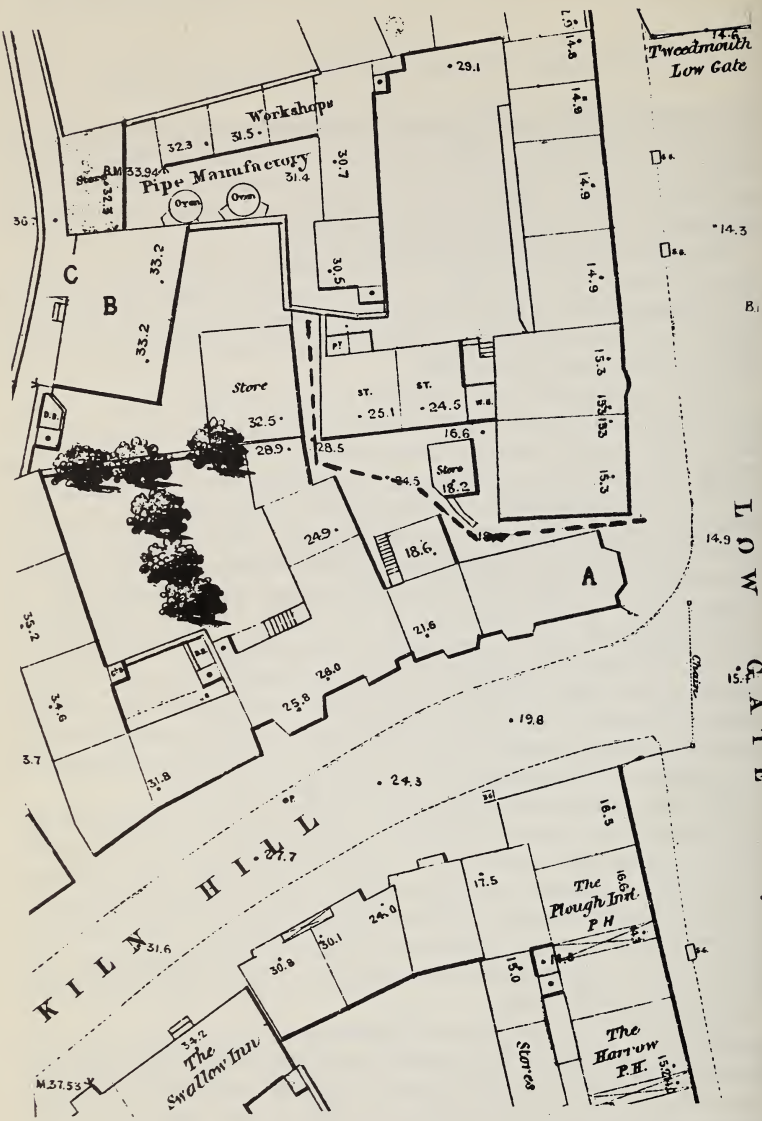

Fig. 1. Part of Board of Health map of Tweedmouth (1852) showing the location of the factory. Scale: 10 inch = 1 mile (1/6336); 1 inch = 176 yards. Reproduced by kind permission of the Berwick Record Office.

Low Gate is now Main Street. A – 84 Main Street. B – 13 Yard Heads. C – Yard Heads. The path to the factory is shown dotted.

with hundreds of small-scale makers in various centres throughout England, Wales and Scotland. During the 1840s, with the rapid growth of the working population, clay pipes were in greatly increased demand. At the same time tobacco became cheaper; manufacture of pipes moved from small units to factories, while at the same time techniques also improved; in consequence the size and quality of the pipes improved.

In the 1851 Census returns, Charles Tennant was described as 'pipe-manufacturer'. He was beginning to expand the business he had bought. From the map of the Local Health Board (1851) and the Ordnance Survey Map of 1852 there were a number of workshops and two kilns on the site, suggesting that the factory was well established before 1851 (Fig. 1). These workshops were stone buildings with tarred roofs built against the walls of a so-called garden, but the exact limits of the property are difficult to determine; the positions of gates, etc., are not clear. The kilns (ovens) were set very close to a house, enclosed by a wall, which was a separate property. Ten years later, in 1861, there was also one son in the business, William 22 years old; the business then was employing 13 men and 5 women. Six pipe-makers and a labourer are recorded as living in Main Street and Kiln Hill, Tweedmouth at that time.

In 1863 Charles Tennant bought the house and shop in Main Street. In 1867 he bought the land on which his factory stood. The report, in the *Berwick Journal* of September 1864[4], of a fire on the premises, gives us a contemporary account of the factory: "As the business increased, Mr. Tennant was compelled to add building to building until the premises now occupy a large irregular plot of ground which includes clay stores, furnace yards, drying sheds, packing rooms etc., and at one side of the premises is a large stable which was filled with hay which was used for the purpose of packing." Mention is made of Mr. Tennant supplying orders at a distance – it was evidently a thriving business.

The business continued to prosper so that by the 1871 Census the firm was employing 18 men, 12 women, 4 girls and 1 boy.

It was the practice for pipe-makers to be men whose work was finished by their wives. Seven such pairs living in Tweedmouth can be identified in the 1871 Census, together with three girls and five men. In 1881 there were at least six pairs of workers listed as tobacco pipe-makers and tobacco pipe-finishers.

From the *Tobacco Trade Review*[5,13] we learn that in 1871 a deputation of tobacco pipe makers requested from Mr. Charles Tennant a salary advance of 18 per cent. This request was granted and the wages were increased from December 1st. Evidently the turnover could stand the increase. His elder son, William, was described in the Census of that year as a Traveller in Tobacco Pipes, presumably selling the products of the factory.

Early in 1873 William moved to Newcastle and started his own

pipe manufacturing business. One surmises that there was a family row since Charles made a Will in February 1873 in which William is not mentioned. Later that year Charles Tennant died, aged 68 years, and left the business, known as Charles Tennant & Son, to his second son, Robert; and the land and £20 a year to his widow until her death. He also left to Robert the right for his work-people to use the WC in the building, formerly a hay-loft, in the Yard behind 84 Main Street. His widow continued to live at the grocery shop and house. After his father's death, Robert Tennant continued to trade as Charles Tennant & Son, as is testified by a bill head for 1898 in the possession of Mr. Francis Cowe.

A description of Charles Tennant was included in the 1884 *Berwick Journal* account of the pipe works[1]: "though not trained to the business the late Mr. Tennant's shrewd business qualifications and admirable urbanity of manner soon formed a connection amongst the merchants in the surrounding towns.... He took a lively interest in several matters of local interest, and the remembrance of his burly form and quiet smile call up vivid recollections of as hard-working, industrious and worthy a man as ever crossed the Berwick Bridge." He was a Town Councillor from 1871 till his death in 1873.

Adjacent to the factory was the property known as 13 Yard Heads which consisted of a house and a large stone building, formerly a bakehouse, later a joiner's workshop. This belonged to a joiner, George Brown. On his death in 1877, Robert Tennant bought 13 Yard Heads from his brother, John Brown, for £455 and the factory and house became one property.

Robert must have transformed the property considerably. Water storage cisterns of brick were built against the walls of the former joiner's workshop. At some time a bathroom was installed in the house and a drain had to be constructed across the yard. There was no main water supply before 1906; we know that water had to be pumped up into the bathroom at that time. The yard must have been unpaved at first, for pipes and fragments were buried in the soil to a depth of $1\frac{1}{2}$ feet in a haphazard fashion. Later the yard was covered with concrete, perhaps when the bathroom was installed, or even later, after 1920, when the property was sold.

By 1884[1] there were 30 men and 30 women employed in the factory. There was an engine used for driving a saw mill and other machinery. The saw mill was used for cutting wood to make the boxes in which the pipes were packed.

In 1884[1] it was written: "Robert Tennant is thoroughly master of his business and has had 30 years' experience and acquired a correct practical knowledge in every department. He is quite at home while engaged in every branch of the business from sweeping the floor to the most artistic branches of his trade."

In 1887 Robert Tennant's wife, Sarah Wilson, died, leaving him

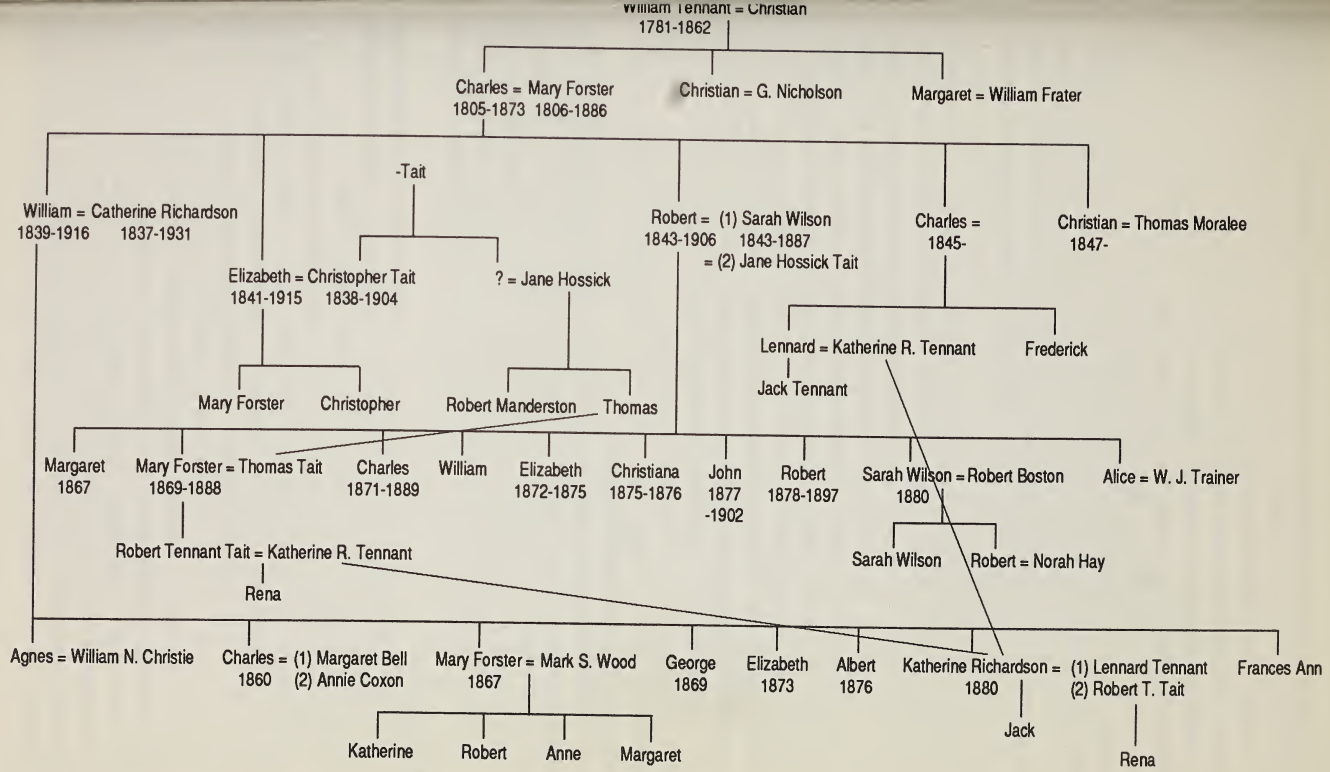

Fig. 2. The Tennant Family Tree.

with eight children, ranging in age from 20 to 6 years, by Sarah his first wife. In the same year that she died, he married Jane Hossick Tait who had had two sons by her first marriage, Robert and Thomas. Robert Tennant's second child by his first wife was Mary Forster Tennant, who married Thomas Tait. They went to London where she died aged only 19 years leaving a son, Robert Tennant Tait (referred to in the rest of this paper as R. T. Tait). He was brought up in 13 Yard Heads by his grandfather (Robert, through his mother) and his grandmother (Jane, through his father) (Fig. 2).

In 1906 Robert Tennant died of a heart-attack, aged 64, leaving the property to his two surviving daughters (none of his sons reached maturity) and to his grandson, R. T. Tait, subject to the life-interest of his widow.

Meanwhile Katherine Tennant, daughter of William Tennant of Newcastle, had married her cousin, Robert's nephew, Lennard Tennant. Unfortunately Lennard died young, leaving young Kate with a son, Jack. She returned from London to Berwick in 1907 and married her first cousin, once removed, R. T. Tait, as her second husband. Robert's widow, Jane, moved to the grocer's shop at 84 Main Street, Tweedmouth. In 1913, R. T. Tait bought out his aunts, the daughters of Robert Tennant, for £468, and thus became sole owner of the factory and the house. In November 1913 the business was registered as a Limited Company to carry on the business of Clay Pipe and Hearth Stone Manufacture.[6] The capital consisted of 2,000 £1 shares, though only 424 were allotted. R. T. Tait and his wife K. T. Tait were directors.

By 1915 there was only half the work-force that had been employed in 1884. This was to be expected for by then the day of the clay pipe was over. The cigarette, first introduced from Turkey after the Crimean War, had taken over in popularity by the beginning of the Great War. Pipe smokers in later Victorian times had begun to prefer meerschaum pipes from the Continent and later English briar pipes.

On Wednesday the 10th November 1915 there was a disastrous fire which gutted the factory. The following is a resumé of the report in the *Berwickshire News* of the 16th November 1915[7]:

About 1 o'clock yesterday morning fire broke out in Tennant's pipe-works, Tweedmouth, the present owner of which is Mr. R. T. Tait. The outbreak was discovered by Miss Wood, a niece of Mrs Tait who occupies a bedroom overlooking the factory. By the time the discovery was made the flames, fanned by the strong wind, had taken a firm hold of the building, the roof of which was of wood, and thickly covered with tar. The house was seen to be in danger so Mrs Tait and three other young occupants were taken to Mr. W. A. Trainer in Blakewell Road. When Mr. Trainer arrived the factory was already doomed and flames began to spread to the house; window frames were burnt through. Mr. Trainer with two fire-

extinguishers brought from his laundry extinguished the flames in the house.

Shortly after 2 o'clock the Fire Brigade arrived. Sparks flew over the tops of the houses but then rain fell. Strenuous work of firemen under the direction of the Borough Surveyor (Mr. R. Dickenson) confined the flames to one building; two hoses were used. After two hours the fire had done its worst, but it was not subdued until 7 o'clock. some occupants of neighbouring houses removed their household goods. The factory was completely gutted; all that remained was charred and cracked walls, twisted masses of iron which had been machinery, and smouldering debris. The back part of the dwelling house was badly damaged by flames, heat and water. The total damage is estimated at about £1,000 – the greater part covered by insurance. It is supposed that the fire was started by a spark from the kiln which had been used on the Tuesday. Thirty employees were thrown out of work, including Mr. R. Evans who had worked there continuously for 34 years.

R. T. Tait then set up a small hearthstone factory in the West End, Tweedmouth to provide work for his employees. This also was burnt down in January 1916[8]. R. T. Tait enlisted then as a despatch rider, and the firm of Charles Tennant & Son Ltd. was dissolved on January 4th,1918. The premises were sold in 1920 and R. T. Tait set up as a tobacconist in Castlegate, Berwick upon Tweed.

The Process of Manufacture

We do not know where Charles Tennant obtained his clay, which presumably, would be off-loaded at a jetty on the south side of the river. By 1884[1] the clay from which the pipes were manufactured came from a bank of pipe clay found at Newton Abbott in Devon. Robert Tennant used three different types of clay in the preparation of his pipes. Ship-loads of this clay arrived at the quay in the then recently built docks in Tweedmouth.

Presumably the blocks of clay (about 10 in. cube) would be carted to the entrance of the right of way next to 84, Main Street. This was too narrow for a horse and cart and there are two traditions as to how the clay reached the factory. Either that the blocks were put in a wheel-barrow with one man pushing at the back and another pulling on a rope at the front, and so were hauled up the steep cobbled slope; or that they were carried in two buckets on either side of a yoke. Coal or coke required for the engines and the kilns must have been carried by the same route.

A vivid picture of the activities of the factory is supplied by the *Berwick Journal* of 1884[1]: "An engine is used for driving a saw-mill, and other machinery connected with the business. The saw-mill is required for cutting wood to make boxes in which the pipes are packed for transit to customers. In the mill-house the clay is ground down into meal from the solid lumps in which it is sent from the

clay banks.... After the clay is taken from the mill-house it is spun into shapes, and then arranged on the low benches at which the pipe-makers work. The damp clay is placed into a mould which is closed and placed into a chest. The chest is closed upon the mould by a lever which is placed on the bench close to the pipe-makers' seat. After this a hole is bored through the shank of the pipe by means of a wire. The process is simple yet difficult. It is the labour of years to become an expert pipe-maker. Sheep's wool damped with oil stands on a little dish on the bench in which each pipe is rubbed before it is placed in the mould. This process of moulding the pipe after the clay has been prepared is done remarkably quickly. An expert pipe-maker will make a pipe in less than a minute. The pipes are then placed on a long case on which they are arranged in front of a stove and stiffened before they are sent into the finishing room to be dressed by women.... After the pipes are finished they are taken to the packing house where they are arranged in round 'saggers' and placed in the kiln, and after they have been fired they are ready for smoking."

According to the memory of Jack Tennant: "clay to seal the kiln was made from mud and dust swept off the street from between the cobbles complete with manure to give it bind."[9] It was in the firing of the kiln that the skill lay; it was said that Robert Tennant would test the quality of any particular batch of pipes by tapping a stem on his teeth.

The final stage was to treat the mouth-piece of the pipe to prevent the clay sticking to the smoker's lip. The cheapest method was to dip the end in a mixture of water and pipe-clay and polish it. For a better quality result a mixture of soap water and gum was used. Some of Tennant's pipes were dipped in brown lacquer. The finished pipes were packed in boxes, in hay in the early days; later wood shavings or sawdust were used. Although the pipes might be sold for as little as a farthing each, some of Tennant's pipe-makers earned an average of £2 a week.

The final shape and design of the pipe depended on the moulds. These were made by specialist mould makers, but there is no information as to where Tennants obtained their moulds. There is a tradition that after the 1915 fire the moulds were given to Christies of Leith to whom the Tennants were related by marriage. There is no evidence, however, that Christies did, in fact, receive them.[10]

The Output of the Factory.

There are five sources of evidence for the patterns of pipes made in the factory. The first is the garden of 13 Yard Heads, the site of the factory; the second is a small quantity of pipe-clay buried by the path into the factory; the third is the back yard of 13 Yard Heads; the fourth is labelled pipes, obtained by clay pipe researchers from localities other than the factory; the fifth is documentary.

From the first source, the garden of 13 Yard Heads, hundreds of bowls, stems and fragments have been collected since 1963 in the course of cultivating the garden. No complete pipes have been found in there, nor have any of the fragments been smoked; all are parts of "wasters" from the manufacture. Many of the fragments are badly weathered and it would be tempting to assume that these are the oldest. Two types of white clay have been used, one less dense than the other, and it is this less dense clay which has weathered badly. One might surmise that Charles Tennant's early techniques were to blame. Possibly the firing was at fault, if it were not that some of his pipes were of a fine quality and some of the stems labelled "Tennant & Son" of late date were equally badly weathered. Perhaps some pipes and stems have been subject of more mechanical turning over of the soil in the last seventy years; but this does not seem likely either, so that the quality of the clay and of the firing seem the most likely causes of differences in weathering.

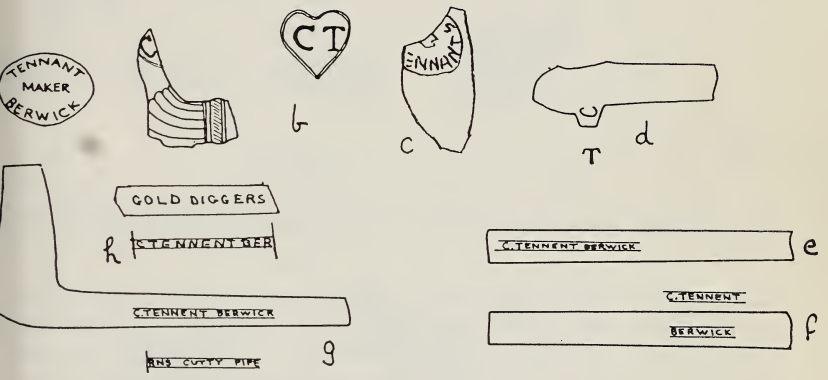

Fig. 3. Various labels by Charles Tennant. (c), (h) del. J. E. R., the rest del. P. J. H.

Charles Tennant marked some of his pipes in the following ways: "Tennant – Maker – Berwick", stamped on a fragment of bowl (Fig. 3,a): a pipe found locally is so marked and the bowl is cutty-shaped[11]; "C.T." within a heart on the bowl of a fluted pipe and a plain pipe (Fig. 3,b); "Tennant" as part of a stamp on a fragment of a bowl (Fig. 3,c); "C" on one side of the spur and "T" on the other (Fig. 3,d); some stems marked "C. Tennent Berwick" (Fig. 3,e); and some marked "C. Tennent" on one side and "Berwick" on the other (Fig. 3,f). A stem fragment found in a garden nearby was marked "C and T" on the spur and "C. Tennant Berwick" on the stem. This is the only instance known of the spelling C. Tennant; all other labels of this type are C. Tennent – a spelling error by the mould

maker. A number of stems and a part bowl are labelled "Burns Cutty Pipe" on one side and "C. Tennent Berwick" on the other (Fig. 3,g). One stem, labelled "C. Tennent Berwick" on one side was marked "Gold Diggers" on the other, maybe an advertisement for a brand of tobacco (Fig. 3,h).

At some point Charles adopted the label "Tennant & Son" on one side of the stem and "Berwick" on the other. There is no way of

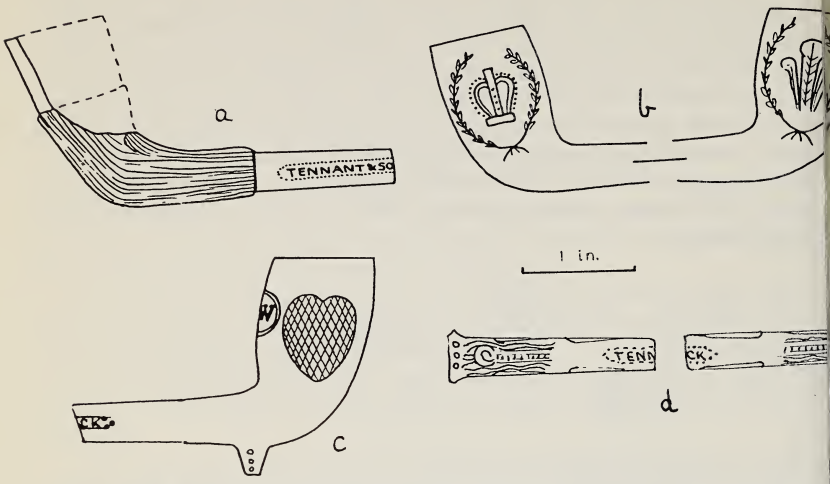

Fig. 4. Pipes labelled Tennant & Son, Berwick. (a), (b), (c) del. P. J. H. (d) del J. E. R.

knowing for certain when this was. Maybe the firm became Tennant & Son when Charles in 1867 bought the land on which the factory stood, and his eldest son, William was 29 years old and Robert was 25. More probably, the change took place in 1873 when William left for Newcastle and only Robert was making pipes with his father. There were 42 years of production still remaining after 1873, so it is not surprising that so many stems labelled "Tennant & Son" have been collected in the garden. This new label was used on a bowl modelled as a pony's hoof (Fig. 4,a). Many bowls of a Prince of Wales feather design were found in the garden (Fig. 4,b). P. J. Hammond found a similar one labelled "Tennant & Son, Berwick" at Hawes. Also some T W pipes had been similarly labelled (Fig. 4,c & 8,c). The stamp 'TW' was widely used by many pipemakers in Scotland and by some in England. It is not known what the initials signify. Ornamental stems were found, one of which bore the Tennant label (Fig. 4,d); no bowl has been found belonging to such a stem.

Besides the types listed above there are at least twenty different unmarked bowls, many of them in considerable numbers. It would

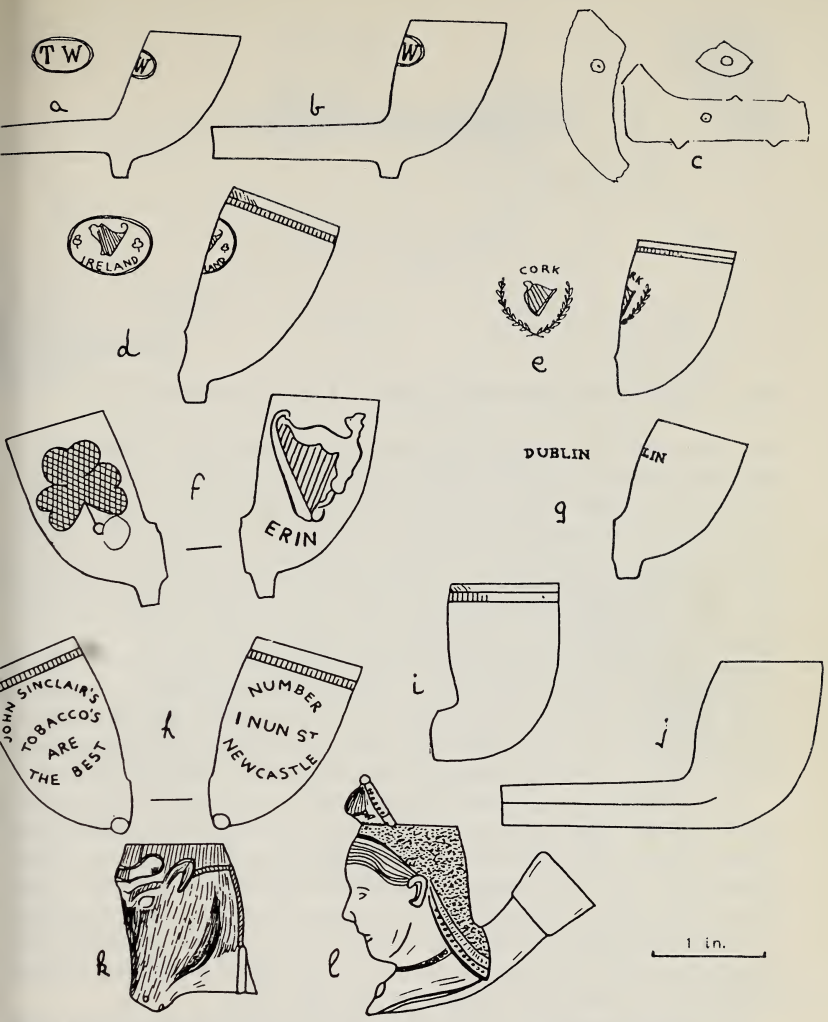

Fig. 5. Unlabelled pipes from the garden. (c) del. J. E. R., the remainder del. P. J. H.

be tempting to assume that all were made in the factory; but three early pipes of seventeenth century types were found in the garden soil, presumably dropped while it was still unenclosed common ground, possibly a drying green. Pieces of pipes from other manufacturers have also been found; a bowl fragment stamped "Porsdike Maker of Manchester", stems labelled "G. Stonehouse of Gateshead", "J. Jolly of Montrose", "Bell of Bishop Auckland", "W. Brewster of Sunderland". Maybe pipes were exchanged at pipemak-

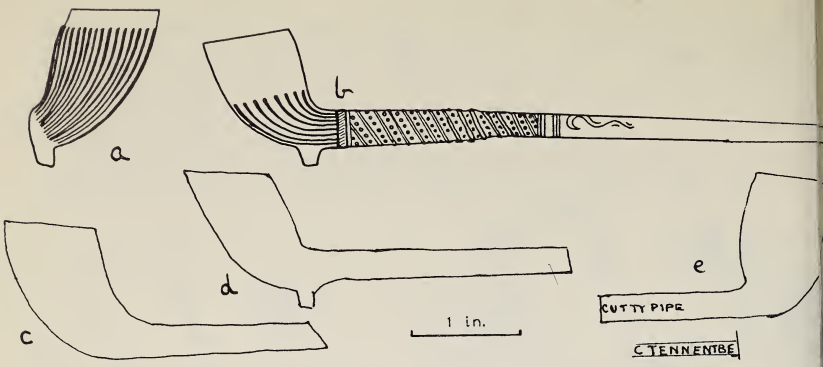

Fig. 6. Pipes found in pipe clay. (a) del. P. J. H., (b) – (e) del. J. E. R.

ers' Conventions, brought back and later discarded. However, it can safely be assumed that where there are a number of specimens of a certain design the pipe was made on the premises even though unlabelled. There are at least five different T W pipes (Figs 5,a & 5,b); as clay is abrasive no doubt moulds had to be renewed from time to time and would vary slightly. There was a thorn design (Fig. 5,c), spurred pipes with the bowl stamped Ireland within an oval frame enclosing a harp and shamrock emblem (Fig. 5,d). There are single specimens of other Irish themes, (Figs 5,e, f, & g) which could well be derived from elsewhere. There must have been a contract with John Sinclair of Newcastle to supply pipes stamped 'John Sinclair's tobacco's are the best' (Fig. 5,h). These bowls had two small spurs one on each side, so that the bowl would rest firmly.

There are many varieties of plain bowls, some cutties, some with spurs, some milled at the top (Fig. 5,i), some heavily made Irish types, some with small thin bowls. One is an imitation of a briar pipe (Fig. 5,j). Two fragments marked RAOB and a bowl in the shape of a bullock's head (Fig, 5,k) suggest that pipes were supplied to local branches of the Royal Antediluvian Order of Buffalos. One head of Queen Victoria for use with a vulcanite stem was almost certainly not made by Tennant & Son (Fig. 5,l).

The second source of evidence was in the lumps of pipe-clay buried at some time during the life of the factory, beside the path. Bowls and stems of at least eight designs were embedded in the clay and the soil surrounding it. Two of the designs had fluting spirally or ribbing on the bowls; one of these had a short spirally-ornamented stem followed by a long slender plain stem; the whole stem was at least $4\frac{5}{8}$th inch long (Figs 6,a & b). There were three or four different patterns of T W pipes, a plain cutty of Irish type (Fig. 6,c), a basket weave and ribbon design without Berwick on the stem (similar to Fig. 7,a) and some plain spurred bowls (Fig. 6,d). None of these could be matched with pipes found either in the garden of

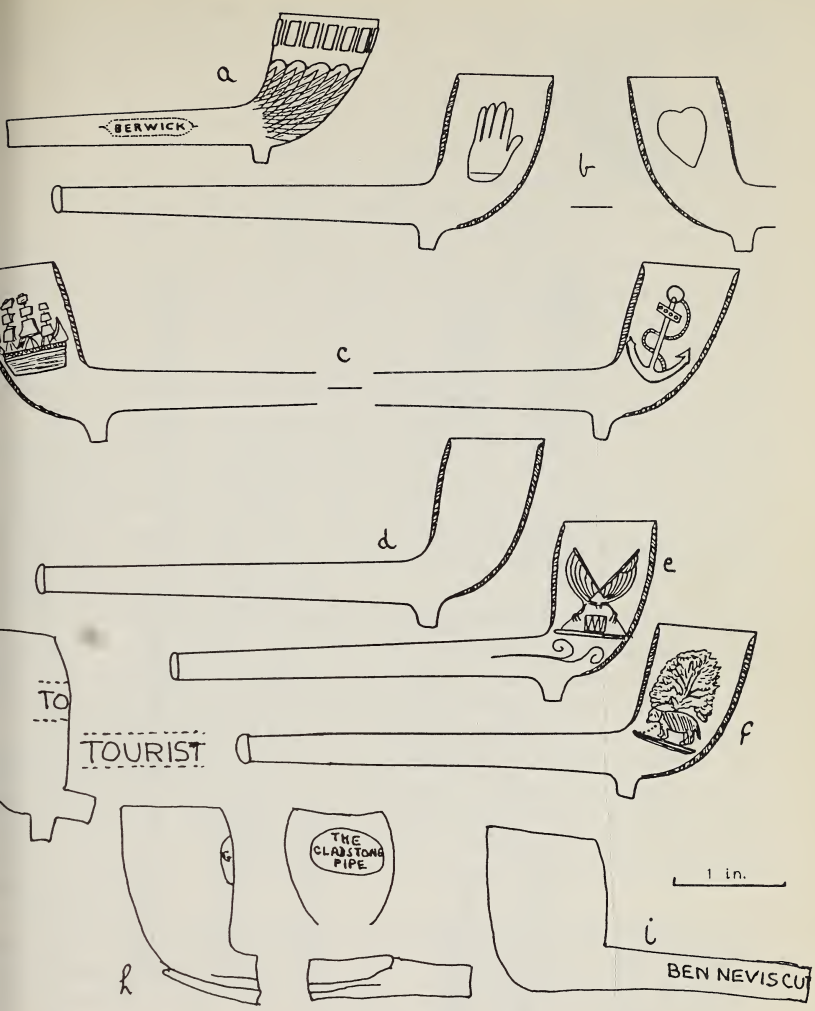

Fig. 7. Pipes under concrete in yard. (a) – (f) del. P. J. H., (g) – (i) del. J. E. R.

the yard. But there were some Burns Cutty pipes, the stems labelled "C. Tennent", similar to Fig. 3,g so that one wonders if they were buried before the 'Tennant and Son' label had come into use (Fig. 6,e). Since pieces of the spirally ornamented stems have also been found in the garden, I incline to the view that the pipe-clay was buried before 1873. The pipe-clay has small fragments of charcoal and coke embedded in it; maybe it was buried because it was too dirty to use. One wonders if the many slender pieces of stem, $\frac{1}{8}$ inch

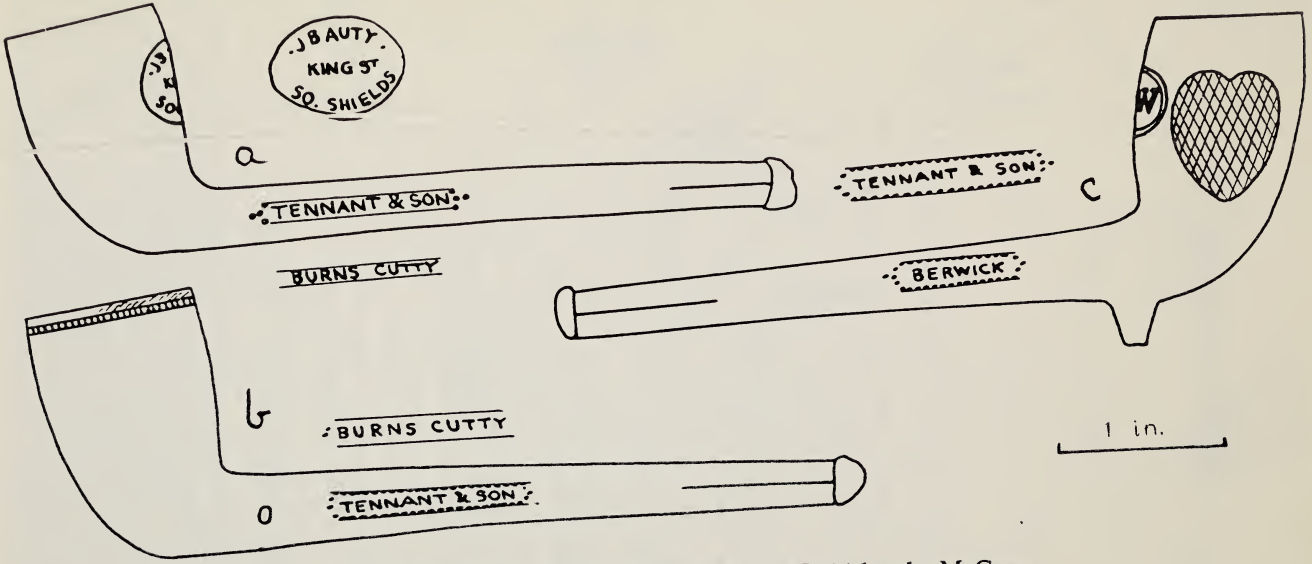

Fig. 8. Pipes from other locations. Del. P. J. H., (a) lent by M. Green.

(3 mm) in diameter were derived from some "churchwarden" pipes, but there is no evidence for this. Three and a half inches (90 mm) seems to be the usual length of a Tennant stem.

The third source of evidence was the back yard of the house, 13 Yard Heads. Robert Tennant did not acquire this property until 1877, so the pipes found there were being manufactured after that date. In 1987, during the repair of a drain crossing the yard, concrete was removed and in the soil immediately underneath were a great many complete pipes and pipe fragments. It is known that the drain had been repaired once before so that the soil had been disturbed at least twice. The concrete could have been laid any time after 1877 whenever the bathroom in the house was installed, but it could well have been after the property was sold by R. T. Tait in 1920. It appears that many pipes, no longer required after the fire, were used as hard core under the concrete in another part of the yard.

Figs 7,a-f show the pipes found in the soil and also those used as hard-core. But in the soil well below the surface were specimens of T W pipes with hearts labelled Tennant & Son, two bowls with the harp and Ireland symbol (Fig. 5,d), a plain straight sided bowl labelled Tourist (Fig. 7,g), a bowl stamped "The Gladstone Pipe" (Fig. 7,h) and a Ben Nevis Cutty (Fig. 7,i). I doubt if the last three were made on the premises.

The moulds used for making T W pipes and the Ireland pipe were different from those used to make similar pipes found in the garden. Some of the designs were made in a grey clay as well as the usual white. Sometimes a pale biscuit coloured clay was used.

The fourth category of evidence is provided by three complete pipes, found away from the factory, labelled "Tennant & Son". One was a Burns Cutty with a bowl stamped "J. Bauty", a tobacconist in South Shields (Fig. 8,a), a Burns Cutty pipe with a milled top (Fig 8,b), and a "T W" pipe (Fig. 8,c). In addition a stem labelled "Tennant & Son" on one side and "Workman" on the other has been found at Duns.

The documentary evidence is provided by the 1884[1] article which refers to Tennant's "T W" pipes and "his celebrated 'Burns Cutties' and fancy pipes artistic in design". R. T. Tait registered in 1911 as trade-marks a Motif "Tennant's Idl" and in 1912 the same but larger in size, and in 1913 the Motifs "Border Gem", "Clipper", and "Zenith"[12]. None of these has been identified, with the possible exception of the "Clipper" (Fig. 7,c).

I have collected a great many mouthpieces. A small number have a rounded end with no flange and would appear to be early. The remainder end with a flange, the shape depending on whether the stem is flattened, elliptical, diamond-shaped, or circular. A very few slender stems, $\frac{1}{8}$ inch (3 mm) in diameter have no flange and are covered in brown lacquer.

Distribution of the Pipes

We learn from the *Berwick Journal*[4] account of the 1864 fire that "Mr. Tennant has of late been busily engaged in supplying orders at a distance". We know that pipes were transported by rail as far as Jedburgh and Hawick because Charles was charged before the local Magistrate early in 1872 for sending not only pipes but matches and fuses with them. The latter articles were dangerous and their presence should have been declared. He was fined £20 and allowed to withdraw three other boxes[13]. The *Berwick Journal* of 1884[1] states that "the numerous customers were found in every town, village and hamlet on both sides of the Borders and large orders were sent to London, Manchester and similar large towns". Tennant's pipes have been found in gardens and waste ground in the Borough of Berwick upon Tweed, in Wooler, Eyemouth and Gavinton near Duns[14]. There is a family tradition that an order for pipes came from Australia after the fire but could not be executed.

In conclusion a picture emerges of a small firm which grew steadily throughout the nineteenth century and then declined as the clay pipes that it manufactured began to be superseded. At its height it provided considerable steady employment for the small village of Tweedmouth and sent its products far beyond Northumberland. One of its sons removed to Newcastle upon Tyne and used the skills learnt in Tweedmouth to start the new firm of William Tennnant.

ACKNOWLEDGEMENTS

I would like to thank the following: Mr. P. J. Hammond for providing extracts from the Census Returns for 1851, 1861 and 1871, and from the Tweedmouth Parish Registers, the Tobacco Trade Review, and the Register of Limited Companies. He also contributed many of the drawings; Mrs M. Skehel (née Tennant) for information about the marriage of Charles Tennant, his purchase of land, his Will and for the Tennants' family tree; Mr. Francis Cowe for the articles from the *Berwick Journal*.

REFERENCES

1. *Berwick Journal* October 16th 1884 "Berwick Industries no. VI 'Tennant's Pipe Works' ".
2. Parish Register of Tweedmouth (St Bartholomews's).
3. Tweedmouth Manor Court Book.
4. *Berwick Journal* September 16th 1864.
5. Tobacco Trade Review December 9th 1871
6. Companies Register 1913.
7. *Berwickshire News* November 16th 1915.
8. *Berwickshire News* February 1st 1916.
9. Skehel M., personal communication.
10. Gallagher D., personal communication.
11. Fordy M., personal communication.
12. Hammond P. J. (1985). Registered and Patented Clay Tobacco Pipes. British Archaeological Reports, 146.
13. *Tobacco Trade Review* January 13th 1872.
14. Cleat L., personal communication.

THE BOTANIST'S SCOTLAND – BERWICKSHIRE (VC81 – BERWICK)

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Clarilaw, Hawick

Berwickshire is an excellent place in which to obtain a grasp of the natural and human forces that determine Britain's botany. It is truly a border county in the sense that here one can study southern and northern plants intermingling at the limits of their respective ranges in an area where heath vegetation has descended to low elevations. In a county affected by the remorseless advance of agriculture and forestry one can still enjoy the rugged coastline, the majestic Tweed and the grouse moors of the Lammermuirs.

The geology is varied. Calciferous sandstone and a trace of limestone underlie the agricultural land of the Merse from Coldstream to Duns and Berwick and outcrop on two stretches of the coast. To the west lie basaltic lavas, dramatic at Hume Castle, which soon give way to a wide band of Old Red Sandstone deposits in the Leader valley, the low moorlands near Greenlaw and the former post-glacial lakes in the Gordon area. To the northeast lie the Silurian rocks of the Lammermuirs extending right to the coast at Coldingham Moor. Volcanic intrusions add interest at St Abb's Head, the Dirrington Laws, the craigs at Sweethope and Hareheugh and at The Black Hill at Earlston.

The coast with its cliffs and sea braes provides a largely unbroken strip of natural grassland and maritime heath where *Primula vulgaris* and *Hyacinthoides* are abundant for about 30 kilometres from Lamberton to Dunglass (near Cockburnspath). Below Lamberton the grasslands are base-rich, with *Koeleria* and *Carlina*, while the wet flushes contain *Equisetum telmateia, Lythrum salicaria, Eupatorium cannabinum* and *Carex pendula*. The railway cutting behind has been colonised by *Pastinaca, Valerianella locusta* and *Bromus erectus*. The braes north of Burnmouth are the most colourful in Berwickshire with *Vicia sylvatica* and *Geranium sanguineum* together with *Poterium sanguisorba* and long-established *Petroselinum crispum*. At Eyemouth, the headland behind Gunsgreen has a fine spring flora with *Primula veris, Orchis mascula* and a late-flowering colony of *Scilla verna;* it also retains a small colony of *Schoenus nigricans*. Below Coldingham, the Linkim Shore and Coldingham Bay provide a more varied habitat with *Ammophila* and *Leymus* together with *Thalictrum minus, Cakile* and *Spergularia marina*.

Here attempts to fix the eroding sand dunes with mesh have provided a habitat for *Montia perfoliata*. At St Abb's Head, the varied and magnificent topology provides both exposed sea cliffs with *Sedum rosea* and *Ligusticum scotticum* and also sunny inland cliffs with *Minuartia verna, Trifolium striatum* and *Torilis nodosa. Astragalus danicus* and *Viola canina* favour the edges of the knowes above,

while *Artemisia maritima* occurs on the stacks at Petticowick. The superb coastline continues north to Fast Castle with its *Asplenium marinum* behind which lies the stark Dowlaw Dean with *Sedum rosea, Thalictrum minus, Allium vineale;* it is also one of the ancient stations for *Chamaenerion angustifolium.*

Pease Bay has been largely surrendered to holiday makers but near Reed Point *Glaucium flavum* survives; there is also a tiny salt marsh with *Parapholis incurva* and *Carex extensa.* Long extinct from the Berwickshire coast are *Smyrnium olusatrum* and *Mertensia maritima.*

Ancient woodland is scarce indeed. The ground flora of the valley elm woods with *Allium ursinum* and *Mercurialis, Saxifraga granulata, Chrysosplenium alternifolium* and *Adoxa* is quite widely preserved but the canopy is often much given over to *Acer pseudoplatanus* and softwoods. Pease Dean on the coast, the Eye Water below Ayton Castle, Clarabad on the Whiteadder, Nabdean at Paxton House and Gledswood near Leaderfoot are some of the best remaining examples of these elm woods. Of these, Pease Dean is notable for its ferns – *Phyllitis scolopendrium, Polystichum aculeatum* and *P. setiferum.* The elm woods intergrade with oak woods and in a few of the richer fragments *Campanula latifolia* is frequent with *Lathraea, Neottia* and *Epipactis helleborine* just surviving. *Arum maculatum* is locally plentiful but perhaps is always an introduction while *Paris* and *Gagea,* present in these habitats elsewhere in the Borders, are absent. Fine oak woods remained at Penmanshiel until the first World War but now those survive, principally along the Whiteadder at Abbey St. Bathans where there is a series of fine woods with *Hyacinthoides, Carex remota, Corydalis, Gymnocarpium dryopteris* and *Phegopteris connectilis,* sometimes with fine juniper. Where these woods approach the river there is *Prunus padus;* and also a well developed alder wood found elsewhere only at Hoprigshiels. In a more open wood at Gatesheugh on the Tweed, *Sorbus rupicola* and *Melica nutans* just survive. In upland situations the deans have much birch and rowan but good examples are rare and the best is at Langtonleescleuch where there is *Rubus saxatilis;* and where *Crepis mollis* may yet survive unlike in its former stations in the Leader valley where it must be presumed extinct. At Airhouse Wood, alone, a sizable remnant birch wood hangs on along an open hillside with *Geranium sylvaticum* and *Rosa pimpinellifolia.*

All these ancient woods are on steep banks and it is perhaps at the Hirsel that long-established secondary woodland gives the best idea of the woodland flora on a more varied terrain; for example at Birgham Wood, on former moorland, there is abundant *Fragaria vesca* and frequent *Pyrola minor* under oak and *Cirsium helenoides* under willow and birch. Native Scots pine woods were extinct in the Borders before 1700 but pine has been extensively replanted especially at Mellerstain and here *Corydalis* has prospered. Some

recolonisation by *Goodyera* and *Linnaea* formerly occurred, from which one colony of *Linnaea* yet survives.

The Tweed as the principal river is much given over to aliens such as *Heracleum mantegazzianum, Impatiens glandulifera, Symphytum uplandicum* and *Allium paradoxum.* Less aggressive introductions are *Butomus umbellatus, Acorus calamus* and *Lysimachia vulgaris. Carex acuta* and *Glyceria maxima* are present as natives. The aquatic flora remains varied with both *Potamogeton lucens* and *P. perfoliatus* plentiful in the lower Tweed. The steep banks support *Dipsacus fullonum* and at least two colonies of *Lactuca virosa* survive. *Cerastium arvense* and *Galium boreale* occur rarely, on rocks, with *Ballota nigra* on sandstone well above the river, and *Parietaria* on walls.

The principal tributary is the Whiteadder whose lower regions lie in a deep, narrow valley where the river swings to and fro with wooded scaurs on one bank and open haughs on the other, backed by grassy braes with much scrub. By the river *Scrophularia umbrosa* is at its most frequent and there is *Oenanthe crocata, Scirpus sylvaticus* and *Schoenoplectus lacustris* with *Tanacetum vulgare* and *Geranium pratense* above. On the braes, *Helianthemum* and *Ononis* are plentiful and here are found *Malva moschata, M. neglecta* and *Carduus tenuiflorus.* The scaurs are typified by *Vicia sylvatica* and *Origanum vulgare* but *Echium vulgare* and *Lathyrus sylvestris* are also present. *Scabiosa columbaria* is found in one side-dean. *Allium scorodoprasum* has one station on the English border. The rich communities of the Whiteadder haughs, between Allanton and Paxton (of which the best is Tibbie Fowler's Glen – only marked on the 1:10560 scale maps), have diminished, losing, e.g., *Trifolium fragiferum* and *Blysmus compressus*, formerly present.

The Blackadder is a tributary in turn and, although the upper reaches have an upland character, *Berula erecta* is plentiful and *Blysmus compressus* is present locally. The Leet Water which drains the Merse is a lazy lowland river with *Carex riparia* and *C. acutiformis* on its banks and in ox-bows. The Leader Water is a gravelly river tending to flood and *Lepidium heterophyllum* is a feature of its gravels.

Away from the river grasslands, interest is concentrated on volcanic craigs. Hume has much *Saxifraga granulata* with *Vicia lathyroides* and *Myosotis ramosissima* with the two *Cerastiums, C. diffusum* and *C. semidecandrum.* Hareheugh Craigs support *Viola lutea, Dianthus, Scleranthus annuus* and *Carex muricata.* Away from the craigs, rich old grassland is rare in lowland Berwickshire; for example there are just a few colonies of *Viola lutea*, only one of which, near Corsbie, is associated with *Botrychium lunaria.* Coldingham Moor was formerly an area of a rich variety of grassland and heath but it is much reduced and, although *Filago vulgaris* and *F. minima* remain on dry knowes, species such as *Gentianella campestris, Gymnadenia conopsea* and *Coeloglossum viride* are lost or

nearly so. The undulating ground of the Merse proper, between Coldstream and Chirnside, is also an interesting mixture of communities with a few northern plants mingling with a notable collection of southern ones. *Galium boreale* and *Trollius europaeus* grew with *Silaum silaus*, *Cerastium arvense* and *Genista tinctoria*. *Filipendula vulgaris*, *Senecio erucifolius*, *Pulicaria dysenterica* and *Equisetum hyemale* were also present. *Apium nodiflorum* and *Berula erecta* were found in the burns. Now, *Galium boreale* and *Silaum silaus* just survive, incongruous at the edge of wheat fields, with a little *Berula erecta* in the burns; but the other species are believed lost. By the Crook Burn alone, a representative northern hay meadow remains, with much *Trollius* and *Cirsium helenoides*.

Coldingham Loch is the only natural water body of significance with *Nuphar lutea* and a variety of linear-leaved *Potamogon* spp, amongst which the current status of *P. filiformis* is in doubt. The Hen Poo at Duns Castle is a flooded mire with a rich flora including long-established introductions and is the principal locality for *Ranunculus lingua*.

The range of mosses is much more restricted than in Roxburghshire and Selkirkshire. Long Moss on Coldingham Common has *Vaccinium oxycoccus*; *Trientalis* is also found nearby on Drone Moss. Former wetland habitats nearby on Coldingham and Lamberton moors, with their strikingly oceanic climates, were stations for *Osmunda*, *Trollius*, *Drosera anglica*, *Apium nodiflorum*, *Epipactis palustris* and *Schoenus nigricans*, but these species are now lost. Dogden Moss on Greenlaw Moor is a fine example of a raised bog with typical species. Gordon Moss has a fascinating history as a remnant of a much larger wetland. *Carex paniculata* and *Dryopteris carthusiana* are still abundant in birchwood there while *Platanthera bifolia*, *Corydalis* and *Catabrosa aquatica* are still plentiful; however, there is a frightening list of extinctions and near-extinctions. Everett Moss (east) has *Cicuta* while Longmuir Moss in the Lammermuirs is the only station for *Carex diandra*. Bemersyde Moss had *Bidens cernua* and *Sanguisorba officinalis*. Mire Loch at St Abb's Head still has *Berula erecta* but *Baldellia* and *Apium inundatum* perished when the mire was flooded. *Corallorhiza trifida* is a feature of several of the Berwickshire mosses. The mires of the Merse are either completely lost or sadly degraded.

Much of the moorland of the Lammermuirs is almost pure *Calluna* with *Erica cinerea* locally dominant while, of the clubmosses formerly frequent, only a little *Lycopodium clavatum* now remains. *Genista anglica* is also localised, though still present on Dirrington Law where it was formerly accompanied by *Arctostaphylos* and *Pyrola media* in an interesting community probably more widespread before it was eliminated by grazing. Not far away *Saxifraga hirculus* and *Leuchorchis albida* have long been lost although *Vicia orobus* still flourishes up the Dye Water and *Parnassia* is still plentiful in base-

rich flushes north of Greenlaw Kaims

A characteristic community of the Lammermuirs is a bryophyte-rich flush where *Sedum villosum* flourishes. *Cryptogramma crispa* is, surprisingly, extinct at several former localities but survives in screes on the Black Hill at Earlston. *Gymnocarpion dryopteris* has fared better on small screes up the Lammermuir burns in just a few of which juniper is still plentiful. Rather rarely up these burns base-rich flushes occur, characterised by *Carex dioica* and *Eleocharis quinqueflora* with *Parnassia, Pinguicula* and *Selaginella.* The Lammermuirs are not high enough for summit vegetation but, amongst the *Empetrum* and *Vaccinium vitis-idaea* on Meikle Says Law, *Rubus chamaemorus* occurs, with *Listera cordata* in the sphagnum. Not all the Lammermuirs are heather and locally there are banks of *Helianthemum* with *Thymus* and *Festuca tenuifolia.* Many arable weeds have become rare or extinct. *Scandix* outlived *Centaurea cyanus,* while *Chrysanthemum segetum* survives near Eyemouth and north of Kelso. *Fumaria micrantha, Stachys arvensis,* and *Lamium hybridum* occur in a few sandy fields near the coast and by the lower Tweed. *Anagallis arvensis* is widespread but scarce and *Mentha arvensis* is now very rare. On the other hand *Matricaria recutita* may be increasing. *Lamium moluccellifoliim* is widely distributed but scarce while the colourful *Galeopsis speciosa* and *Fumaria muralis* are often plentiful, even in peaty upland soil.

BIBLIOGRAPHY

Authors, various. (1831-1987) In: *History of The Berwickshire Naturalists' Club.* For indices to botanical papers, see: 1831-1931, Centenary Vol., 90-95; 1932-1980, Sesquicentenary Vol., 121-129. The Berwickshire Naturalists' Club, Berwick upon Tweed.

Johnston, G. (1829-1831) A Flora of Berwick on Tweed. J. Carfrae and Son, Edinburgh, and Longman, London.

Johnston, G. (1853) The Natural History of the Eastern Borders. J. Van Voorst, London.

Kelly, A., and Shaw, W. (1902) In Thomson, A., Lauder and Lauderdale. Galashiels.

Long, A. G., and Braithwaite, M. E., Manuscript – A card index of the flora of Berwickshire. (with M.E.B.)

Nature Conservancy Council (1960-88) Internal memoranda – Lists of plant species and site reports.

Nature Conservancy Council. Monks Wood Biological Records Centre. Lists of species.

Perring, F. H., and Walters, S. M. (Eds.) 2nd edition, (1976) Atlas of the flora of the British Isles. E.P. Publishing for the Botanical Society of the British Isles, Wakefield.

Scottish Wildlife Trust. (1960-88) Internal Memoranda – Lists of species and site reports.

Thompson, J. V. (1807) A Catalogue of Plants growing in the vicinity of Berwick on Tweed. J. White, London.

AUTHOR'S NOTES

The nomenclature used follows Clapham, Tutin and Warburg (1981, 3rd ed. – Excursion flora of the British Isles. Cambridge, University Press). Linnaean names for plants have been used throughout as it was felt that it would be too imprecise to omit them and too cumbrous to give also English or Border names. In case of difficulty readers are recommended to refer to a modern popular flora with colour illustrations (which may help more than a name) such as: Rose, F. (1981) The wild flower key. (Warne, London) or; Martin, W. K. (1982) A new concise British flora, Ebury Press and Michael Joseph, London.

The Watsonian Vice-County 81 – Berwick, is conterminous with the present County of Berwickshire except for a small area at the head of the Leader Water. It does not include Berwick upon Tweed, which is in Vice-County 68 – Cheviotland. (Dandy, J. E. 1969. Watsonian vice-counties of Great Britain. London: The Ray Society. – Available from the British Museum (Natural History).

SOME SPECIES OF COLEOPTERA NOT PREVIOUSLY RECORDED FROM THE VICE-COUNTIES OF BERWICK (VC 81) AND SELKIRK (VC 79)

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It is probably true that the beetle fauna of VC Berwick has been explored and recorded more fully than that of any comparable area of Scotland with the possible exception of parts of Galloway. That this can be said is owed largely to the work of a number of nineteenth-century naturalists, pre-eminent amongst whom was the indefatigable James, later Dr., Hardy. Others who contributed largely were Prideaux J. Selby, Robert Hislop and George Dunlop. Unfortunately, Dr. Hardy's collection is no longer extant. As it was not the custom of that time to quote the author of a species as part of its specific name, and as the intervening period has seen vast taxonomic and nomenclature changes, it is difficult or impossible to assign with certainty many of these old records to species as known today. To bring the lists of last century up to date, as far as it is possible to do so, would be a valuable undertaking, especially if more modern records were incorporated.

Selkirk, on the other hand, is one of the least well documented of the Scottish vice-counties. The writer is aware of only one fairly comprehensive list (Whitehead, 1904), which, regrettably, is not very reliable and, again, there is no surviving collection to support it. Other records are scattered in short notes in various journals. Many beetle species, even of the commonest, do not appear to have been reported.

The appended lists are not the result of any systematic effort to add to the coleopterous faunas of the two vice-counties. They comprise records of species that were found as a result of other activities, and do not appear to have been previously recorded from the areas.

The nomenclature followed is that of Kloet and Hincks (1977).

BERWICK (VC 81)

Carabidae.

Dromius notatus Stephens Coldingham, 20-6-87. Under a stone on coarse sand just above high tide level.

Staphylinidae.

Tachyporus solutus Erichson Near Polwarth, 26-5-85. Swept from blaeberry, *Vaccinium myrtillus* L.

Aleochara algarum Fauvel Near Coldingham, 20-6-87. Under a stone on grit just above high tide level. The only south Scottish

record. Most records are English but there are a few from NW Scotland.

Cantharidae.

Malthodes flavoguttatus Kiesenwetter Hutton Bridge, 14-7-84. Swept from butterbur, *Petasides hybridus* (L.) Gaertn., Mey. and Scherb.

Scraptiidae.

Anaspis maculata Fourcroy Hutton Bridge, 14-7-84. General sweeping close to the river.

Cerambycidae.

Pogonocherus hispidulus (Piller & Mitterpacher) Gledswood, 16-5-81. Landed from flight on my jacket.

Curculionidae.

Phytobius comari (Herbst) Lurgie Loch, 14-6-80. Taken in fen in pond-net.

SELKIRK (VC 79)

Ptiliidae.

Acrotrichis cognata (Matthews) Near Galashiels, 15-10-85. In rotten toadstool. Apparently the first Scottish record of a southern species.

A. insularis (Mäklin As last. No other Scottish records south of the River Forth but several north of it; mainly English in distribution.

A. intermedia (Gillmeister) As last.

A. strandii Sundt By Yarrow Water, near Sundhope, 15-6-80. In gravel.

Staphylinidae.

Proteinus brachypterus (Fabricius) Near Galashiels, 15-10-85. In rotten toadstool.

P. crenulatus Pandellé As last.

Geodromicus nigrita Müller Rankle Burn, 12-7-86. In moist, gritty gravel.

Eusphalerum minutum (Fabricius) Alemoor Loch Fen, 1-6-80. General sweeping.

E. sorbi (Gyllenhal) Little Yarrow Burn, 6-7-85. On water surface.

Bledius opacus (Block) By Tima Water, 22-7-84. Burrowing in sand on a gravel bank.

B. subterraneus Erichson As last.

Stenus guttula Müller Near Selkirk, 29-8-79. In river gravel near the water.

S. impressus Germar Hartwoodburn, 25-8-79. General sweeping near scrubby trees.

S. niveus Fauvel Blind Moss, 18-9-76. Taken in the fen in a pond-net.

S. umbratilis Casey Crooked Loch, 1-8-77. On emergent plants in the edge of the loch. Probably included with *S. pubescens* Stephens

in earlier reports.
Lathrobium angusticolle (Boisduval & Lacordaire) By Yarrow Water, near Sundhope, 15-6-80. Under stones on gravel.
Quedius maurorufus (Gravenhorst) By Pot Loch, Selkirk, 24-6-78. Under a stone.
Tachyporus pallidus Sharp By Yarrow Water, near Sundhope, 15-6-80. Under a stone on gravel. There are no other south Scottish records but several north of the River Forth; mainly southern in distribution.
Hygronoma dimidiata (Gravenhorst) Goose Loch, 3-8-77. Taken in pond-net.
Hydrosmecta eximia (Sharp) By Yarrow Water, near Sundhope, 14-4-84. In gravel near the water.
Aloconota currax (Kraatz) As last, 17-4-83.
Atheta crassicornis (Fabricius) Near Galashiels, 15-10-85. In rotten toadstool.
A. ravilla (Erichson) As last.

Scirtidae.
Elodes marginata (Fabricius) Rankle Burn, 1-6-80. In flight.

Elateridae.
Fleutiauxellus maritimus (Curtis) Yarrow Water, near Sundhope, 2-7-83. In dry gravel.
Ctenicera pectinicornis (L.) By Rankle Burn, 1-6-80. In flight.

Cantharidae.
Cantharis figurata Mannerheim By Hellmoor Loch, 19-6-77. General sweeping.

Scraptiidae.
Anaspis rufilabris (Gyllenhal) Hartwoodburn, 25-8-79. On raspberries.

Chrysomelidae.
Longitarsus brunneus (Duftschmid) Dry Moss, 28-9-75. General sweeping.
Altica oleracea (L). Goose Loch, 3-8-77. Swept from emergent vegetation at the edge of the water.
Chalcoides fulvicornis (Fabricius) By Yarrow Water, near Sundhope, 2-7-83. Beaten from willows, *Salix* sp.

Curculionidae.
Ceutorhynchus litura (Fabricius) Dry Moss, 28-9-75. General sweeping.

Scolytidae.
Xyloterus lineatum (Olivier) Hartwoodburn, 25-5-74. In flight.

Localities

The following list gives six-figure National Grid map references for the places mentioned above. All are in grid square NT.

Alemoor Loch Fen 386149, Blind Moss 458184, Coldingham 920663, Crooked Loch 353139, Dry Moss 484267, near Galashiels 507346, Gledswood 592342, Goose Loch 351142, Hartwood burn 466267, Hellmoor Loch 382167, Hutton Bridge 880551, Little Yarrow Burn 232188, Lurgie Loch 677395, near Polwarth 732493, Pot Loch 478284, Rankle Burn 325153, near Selkirk 483320, Tima Water 277097, Yarrow Water near Sundhope 325253.

ACKNOWLEDGEMENTS

I am grateful to Dr. Mark Shaw for allowing me to use the collections and the invaluable species distribution index in the Royal Scottish Museum; and to Mr. Colin Johnson (Manchester Museum) and Prof. John Owen (Epsom) for help in identifying some specimens of the families Ptiliidae and Staphylinidae, respectively.

REFERENCES

Kloet, G. S., and Hincks, W. D. (1977) A check list of British insects. 2nd ed. Part 3 – Coleoptera and Strepsiptera (by R. D. Pope). Handbook for the identification of British insects, 2, (3). xiv + 105. London: Royal Entomological Society of London.

Whitehead, J. M. et al. (1904) List of Coleoptera captured in Galashiels and district. *History of the Berwickshire Naturalists' Club*, 19, 194-199.

A GATEWAY ARCH

The pen-and-ink sketch of an arched gateway, which is reproduced below, was found among the papers of the *History* without any attribution other than the signature of the artist on the sketch – A. Connell. The sketch has been shown to the Field Secretaries and to various other members of the Club without it being identified. It is published now in the *History* in the hope that this wider circulation will lead to its recognition; and perhaps to a description of its importance and history.

There is no prize! Except that we shall be glad to publish the names of all those members of the Club who succeed in identifying it!

4 May, Wednesday. (Extra Meeting) This meeting was arranged to visit the GLASGOW GARDEN FESTIVAL. Two coaches were required for Members electing to go. The weather was dull but the event was much enjoyed and many people returned to visit what has become one of the country's most successful garden festivals.

19 May, Thursday. DUNS CASTLE was a most successful and rewarding meeting. Mr and Mrs A. D. Hay were most knowledgeable and courteous hosts to the Club in their historic home. Kevin Rideout of the St. Abbs Nature Reserve was present to show Members the features of the attractive Duns Castle Nature Reserve.

In the afternoon the Club went to C. H. DEXTER'S works at Chirnside where the machinery for manufacturing material for teabags, surgical clothing, etc., was in operation. Members were most impressed by the science and technology displayed. The Club was delighted by the kindness and hospitality of C. H. Dexter in providing tea – an almost unique event for the Club. Our President, Sir William B. Swan was one of the leading figures who were instrumental in persuading Dexters to bring their expertise to Berwickshire.

9 June, Thursday. (Extra Meeting) A botanical meeting at HOLYDEAN, between Bowden and Selkirk, was conducted by our own specialist, Chris Badenoch, supported by Dr. Michael Robson. the Members had a most instructive and enjoyable afternoon's walk around the ancient moss. The meeting was exceptional both for its botanical and its historical associations.

15 June, Wednesday. DALMENY HOUSE. A historic home of many famous people in British political life. Sited above the Firth of Forth in a beautiful position it contains amongst much else, a new room devoted to mementos of the Emperor Napoleon. The valley gardens in late Spring were very beautiful. Lord Rosebery gave a most interesting address, principally on the lovely estate woodlands.

In the afternoon we visited DALMENY CHURCH which is one of the few (including Leuchars, in Fife) remaining gems of Norman architecture in Scotland. The minister, the Rev. Ivor Gibson gave a most informative address.

14 July, Thursday. Over 80 Members braved the downpour of rain at ROUTINGLINN prehistoric fort to hear a talk about the stone inscriptions by Mrs Charlton of the Northumberland National Park Service.

At FORD CASTLE, Lord Joicey, the owner, in his kindly inimitable way, outlined the history of the Castle and conducted parties through the building. The weather had by this time relented and a mild afternoon was thoroughly enjoyed by an increased audience. Members also visited the village hall to see the mural paintings by Lady Waterford.

To round-off the day the club went to FORD HALL where the owners, Mr and Mrs. David Stobart, guided the Members through their most beautiful valley gardens and showed their unusual collection of ornamental waterfowl.

18 August, Thursday. JEDBURGH. At the old, renovated, town-house, known locally as "Queen Mary's House", Mrs Capper, the custodian, outlined its history.

HARDEN. Lord and Lady Polwarth welcomed the Members and showed them the treasures of this historic and beautiful home. The privilege was greatly appreciated because the house is rarely open to the public and then only for charity.

14 September, Wednesday. This was a "Garden Day". First was a visit to BIEL, near Dunbar, where Mr and Mrs Charles G. Spence, most kindly and generous hosts, showed Members their fascinating house and exceptionally beautiful gardens. Next was BELHAVEN HOUSE, home of Sir George Taylor, K.T., D.Sc, F.R.S., who welcomed the Club (of which he is a Member). His interesting and well-known garden was much admired.

Members were interested, afterwards, to view the old houses of Belhaven village.

12 October, Wednesday. As a pleasant finish to the Season and prior to the Annual Meeting, held in Berwick Museum in the afternoon, the Members met in the morning at Tillmouth Park Hotel to hear an entertaining address by the owner, Sir David Burnett, on the history of Tillmouth Park and Twizel Castle. This was very well attended.

While the usual bright "Club Weather" was absent this year an attendance of over 120 Members and guests at each main meeting was gratifying. Afternoon tea was enjoyed at the end of each meeting.

D. and L. Mackenzie Robertson

REPORT OF THE LIBRARIAN – 1988

The Library is housed in the Berwick Borough Museum, which is within the Old Barracks. Its address is Berwick upon Tweed TD15 1DQ. It is available to all members of the Club, and to any other *bona fide* researchers. Tickets for admission to the Library (which also allow free admission to the Museum – itself well worth a visit) may be obtained from the Club's Librarian – Miss M. H. Simpson, 124 Shielfield Terrace, Berwick upon Tweed (Tel. 0289 307805.

The Library is solely a reference one, but, while books may not be borrowed, there are ample facilities for reading and for research in the Museum. Readers are asked to advise the Museum's Curator, Mr Richard Doughty, B.A., P.G.C.A., in advance of their visit (Tel. 0289 308473).

The Library contains a complete set of the Club's *History* as well as an extensive other literature on many matters within the Club's interest. The Library was recently greatly augmented by the late Rev. Stanley Ross's bequest of more than 2000 books. Mr Ross's interest – reflected in his gift – was in all aspects of life in the Border counties and in Northumbria and East Lothian as well. The Ross collection is still in the process of classification but is available to readers. Another important accession to the Library, this year, was the gift, by his daughter, of the document collection of the late Mr. G. E. Davidson; this comprises, as well as many books on Border life, a number of original documents, relating mainly to the history of Abbey St. Bathans.

The Club exchanges its *History* for the publications of the following other societies: The Glasgow Natural History Society; The Natural History Society of Northumbria; The Hawick Archaeological Society; The Society of Antiquaries of Scotland; The Scottish Ornithologists' Club; The Royal Botanic Gardens, Edinburgh; The Scottish Natural History Society; The Glasgow Archaeological Society; The East Lothian Antiquarian and Field Naturalists' Society; The Society of Antiquaries of Newcastle upon Tyne; The Architectural and Archaeological Society of Durham and Northumberland.

A number of members have very kindly given to the Library copies of the *History* which are surplus to their needs and these are gratefully acknowledged. Photocopies of the out-of-print 1981 Part (Vol. XLII, Pt 1) are being made in order to fulfil our commitments for standing orders and exchanges.

LIBRARIAN'S FINANCIAL STATEMENT FOR YEAR ENDED 12 OCTOBER, 1988

Income		Expenditure	
Opening balance	£782.91	Postage	£15.07
Sales of History	23.29	Stationery	1.68
Interest	21.55	Balance forward	811.00
	827.75		827.75

FINANCIAL STATEMENT FOR YEAR ENDED 20th SEPTEMBER, 1988.

INCOME	
Balance in Bank at 21/9/87	£143.83
Subscriptions	
Annual & Libraries	2,407.00
Entrance Fees & Club Badges	77.00
Borders Regional Council, Grant towards cost of Index	500.00
M. E. Braithwaite, to set up Natural History Publication Fund	1,000.00
Sundries	
Sales of Index of B.N.C. *History*	185.00
Additional refund of Income Tax for 1985/86	25.78
Refund of Income Tax for 1986/87	172.17
Visitors Fees at Meetings	106.00
Donations	14.25
Arrears of 1986/87 Subscriptions received	45.00
Sale of Club Ties	13.50
Subs paid twice (refunded)	118.50
Transferred from Deposit Account	2,500.00
	£7,308.03

EXPENDITURE	
Printing (including Index)	£1,794.45
Printers' Postages	211.92
Subscriptions Paid	
Scottish Region of Archaeological Society	8.53
Association for Protection of Rural Scotland	12.00
Sundries	
Refund of Subscriptions overpaid	118.50
Library Insurance	51.67
Spike Hughes Rare Books; for Valuation of 2 Sets of B.N.C History	46.00
Toye Kenning & Spencer; for supplying 100 Club Badges	157.67
Repayment of instalment of Loan for Index	1,000.00
Northern Rock Building Society, to open Moneyspinner Share Account for Natural History Publication Fund	1,000.00
Officials' Expenses	
Mr. & Mrs. D. Mackenzie Robertson, Joint Field Secretaries	597.33
Miss S. G. Stoddart, Treasurer and Corresponding Secretary	185.72
Transferred to Deposit Account	2,071.50
Balance in Bank as at 20/9/88	52.74
	£7,308.03

Balance on Current Account as at 20/9/88	£52.74
Balance on Savings Account as at 20/9/88	£2,681.90
Balance on Moneyspinner Share Account with Northern Rock Building Society – Natural History Publication Fund	£1,000.00

11th October 1988 I have examined the books of Berwickshire Naturalists' Club and from the information provided have found them to be correct and in order.

(Sgd) E. J. Kellie

FIELD NOTES AND RECORDS

There was only one field note sent in to the *History* – by Mrs J. B. Wigdor, of the hearing of a cuckoo at Oxton on the 31st January 1989 – which seemed very likely, considering the mildness of the winter. However, reference to the official Bird Recorder found that this could not be accepted as a record unless supported by a "sighting". Mr R. D. Murray, Scottish Ornithologists' Club Recorder for the Borders, has kindly provided a description of the arrangements for the validation of bird species in Scotland; it is summarized below.

The basis is a network of County recorders who are appointed by the SOC because of their local knowledge and enthusiasm. They are responsible for receiving records, submitted monthly, quarterly or annually, acknowledging all correspondence, collating the observations in their areas and submitting a a summary of these observations to the Editor of the *Scottish Bird Report* who collates the records to form the national report on birds for each year. The *Scottish Bird Report* has been published yearly since 1968.

Since 1979 the Borders County Recorder has published annually, usually in September or October, the *Borders Bird Report*. It contains summaries of the records of all species seen in the Borders for the year. The number of records has increased dramatically since 1979 – some 15,000 reports are dealt with each year. The current *Report* runs to 45 pages and deals with 200 species; some species are covered in one line but for others, such as geese, information can fill 50 lines of text. The *Report* also publishes papers on research or survey; recent publications have covered Mute Swan, Ring Ouzel, Goosander and seabird breeding.

Local Recorders also deal with rarities or unusual observations, in which they are assisted by two bodies. National rarities are considered by the *British Birds Rarities Committee*, which considers species occurring as vagrants; it is staffed by 12 experts in the identification of American, Asian and European birds. The Borders has usually, annually, only one or two of these records; 1988 was a good year having Woodchat Shrike, Lesser Grey Shrike, Pallas's Warbler (twice) and Radde's Warbler. Scottish rarities are considered by the *Scottish Bird Records Committee*. Some "rarities" occur too frequently for the BBRC to consider; for example, over 200 Common Cranes are reported each year in Britain. Scottish observations are relegated to the SBRC; Common Cranes were reported in 4 of the last 5 springs.

Bird species that are rare in Scotland but not in the British Isles elsewhere, are also considered by the SBRC; e.g., Nuthatch, Rough-legged Buzzard and Scarlet Rosefinch. The SBRC also considers records of "out of season" migrants, and of birds in peculiar plumages such as albinos.

For a record to be acceptable, it is essential that a full description

is made *at the time*, not after consultation of field guides which may alter one's memory. Special forms to facilitate recording of occurrences are available from County Recorders.

The County Recorders also deal with the *Rare Birds Breeding Panel*, a body composed from the RSPB and the NCC. Breeding records of rare birds are given to it confidentially. That information, disguised for obvious reasons, is published annually by *British Birds* only under the general title of 'Scotland, south'. In the Borders, the species involved in recent years include: Slavonian Grebe, Goshawk, Pochard, Shoveler, Fieldfare and Brambling.

The recording network is arranged by local authority regions as follows:

Borders: R. D. Murray, 4 Bellfield Crescent, EDDELSTON, Tweeddale, EH45 8RQ. (0968 75286).
East Lothian: P. R. Gordon, Craigielaw Cottage, ABERLADY, EH. (08757 588).
Mid/West Lothian: M. R. Leven, 43 Riccarton Road, LINLITHGOW, EH. (0506 844589)
Northumberland: M. S. Hodgson, 45 Elmtree Gardens, WHITLEY BAY, NE25 8QX. (0632 520511).

Mr Murray notes that the first firm record of a cuckoo in 1989 was about 10 April, about 3 weeks earlier than usual.

ADVICE TO CONTRIBUTORS

The History of the Berwickshire Naturalists' Club has now run continuously for more than 150 years and has recorded a huge amount of information about every aspect of life in the Borders—its archaeology, history, sociology and natural history. It is an invaluable repository for primary information about the Borders and the Club would like to extend its function in this regard. To encourage contributions from people who may perhaps be inhibited by unfamiliarity with the preparation of manuscripts for publication the following notes are included in the *History*.

Contributions

Manuscripts should, if possible, be typed, double-spaced but even handwritten documents, if clearly legible, can be considered. Two copies guard against any loss in the post in the preparation of the MSS for publication. Figures should be numbered consecutively and provided with short descriptive legends. Reference to other publications in the text are most simply done by author name(s) and date of publication and listed in alphabetical/chronological order at the end of the paper. As examples:

Baxter, E. V., Rintoul, L. J. (1953) The birds of Scotland. Edinburgh: Oliver and Boyd.

Boyd, H., Ogilvie, M. (1969) Changes in the British wintering population of the pinkfooted goose from 1950-1975. *Wildfowl*, 20, 33-46.

Taylor, G. (1937) List of fungi observed in the neighbourhood of Cockburnspath. *History of the Berwickshire Naturalists' Club*, 29, 303-313.

Sometimes references to other publications/authors, documents, episodes, etc., in the text are more appropriate by superscript numbers, e.g.: "the house of Netherbyres[5]"
and then related to a numbered entry in a list of references/notes at the end of the paper:

"5. Scottish Record Office TD 78/7."

If other publications are not cited specifically, it may still be useful to give a "Bibliography" to direct the reader to other relevant papers.

Field Notes and Records. Notes of unusual occurrences are welcome and of great value for future workers. For maximum usefulness, they are best reduced to their essentials.

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Contributions can be sent direct to the Editing Secretary, or handed to any Council Member.

HISTORY

OF THE

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